FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Urządzenia i układy automatyki**
Name in English:	**Control Apparatus and Systems**
Main field of study (if applicable):	**Industrial Control Engineering**
Specialization (if applicable):	
Level and form of studies:	**1st level, full-time**
Kind of subject:	**optional**
Subject code:	**APR012105**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	15			30	
Number of hours of total student workload (CNPS):	60			60	
Form of crediting:	examination			crediting with grade	
For group of courses mark (X) final course:					
Number of ECTS points:	2			2	
including number of ECTS points for practical (P) classes :				2	
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40			1.40	

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of basics of discrete and continuous control systems.
2. Knowledge of selection and design methods of digital regulators and controllers.
3. Basic knowledge of Matlab/Simulink software.
4. Practical skills of using MATLAB.
5. Is capable of programming Programmable Logic Controllers (PLC).
6. Is capable of implementing digital algorithms based on difference equations.
7. Is able to cooperate with a team.
8. Is able to think and act in a creative way.

SUBJECT OBJECTIVES

C1. Acquaintance of knowledge related to control systems schemes and elements (sensors, converters, actuators, etc.) employed in automatic control systems of centralized and distributed generation systems.

C2. Practical skills to select, design and analyze digital control systems as well as their physical realization with use of PLC.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 Possesses knowledge related to realization of digital control for centralized and distributed generation systems.

PEU_W02 Has a basic knowledge of the principles of operation and understands functions of elements (sensors, converters, actuators, etc.) employed in centralized and distributed generation systems.

PEU_W03 Possesses knowledge related to design of digital control system appropriate to the determined plant.

relating to skills:

PEU_U01 Is able to identify physical control system (object) – estimating its transfer function – by an experimental approach based on obtained measurements form the system and is able to design and analyze digital control system model using SIMULINK environment.

PEU_U02 Is able to determine transfer function of a digital regulators using various design methods.

PEU_U03 Is able to implement formerly designed digital controller using PLC platform.

relating to social competences:

PEU_K01 Is able to carry out a complex engineering project in a competent way, unaided as well as to cooperate with a team if required.

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Introduction. Setting rules of course crediting. Control systems of centralized and distributed generation units – historical perspective.	2
Lec 2	Sensors, converters, actuators of control systems applied to centralized and distributed generation units.	2
Lec 3	Control apparatus and systems of photovoltaic power plant – solar tracking and maximum power point tracking systems.	2
Lec 4	Control apparatus and systems of wind turbines.	2
Lec 5	Control apparatus and systems of steam turbines.	2
Lec 6	Control apparatus and systems of synchronous generators.	2
Lec 7	Electrical circuit diagrams and technical documentation.	2
Lec 8	Programmable controllers – digital control systems design.	1
	Total hours:	**15**

Form of classes - project		**Number of hours:**
Proj 1	Introduction. Setting rules of course crediting. Acquaintance with lab stands, safety rules and available software. Project problems assignment.	2
Proj 2	Identification of the control object.	2
Proj 3	Design and analysis of digital control system model using SIMULINK environment.	2
Proj 4	Design and analysis of digital control system model using SIMULINK environment.	2
Proj 5	Implementation of various digital control algorithms using PLC platform for a determined physical object. Designed control systems testing.	2
Proj 6	Implementation of various digital control algorithms using PLC platform for a determined physical object. Designed control systems testing.	2
Proj 7	Implementation of various digital control algorithms using PLC platform for a determined physical object. Designed control systems testing.	2
Proj 8	Implementation of various digital control algorithms using PLC platform for a determined physical object. Designed control systems testing.	2
Proj 9	Implementation of various digital control algorithms using PLC platform for a determined physical object. Designed control systems testing.	2
Proj 10	Implementation of various digital control algorithms using PLC platform for a determined physical object. Designed control systems testing.	2
Proj 11	Implementation of various digital control algorithms using PLC platform for a determined physical object. Designed control systems testing.	2
Proj 12	Implementation of various digital control algorithms using PLC platform for a determined physical object. Designed control systems testing.	2
Proj 13	Implementation of various digital control algorithms using PLC platform for a determined physical object. Designed control systems testing.	2
Proj 14	Implementation of various digital control algorithms using PLC platform for a determined physical object. Designed control systems testing.	2
Proj 15	Presentation of final reports.	2
	Total hours:	**30**

TEACHING TOOLS USED

N1. Multimedia presentation.
N2. Informative lecture.
N3. Presentation of the reports.
N4. Matlab program.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation *F – forming (during semester)* *P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEU_W01 PEU_W02 PEU_W03	Participation in the course
F2(W)	PEU_W01 PEU_W02 PEU_W03	Final examination
P(W)	P = 0,1F1+ 0,9F2	
F2(P)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Activity during the classes
F2(P)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	Presentation of the project done
P(P)	P = 0,7F1+ 0,3F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Machowski J., Regulacja i stabilność systemu elektroenergetycznego, Oficyna Wydawnictwa Politechniki Warszawskiej, Warszawa 2007.
[2] Lubośny Z., Farmy wiatrowe w systemie elektroenergetycznym, WNT, Warszawa 2009.
[3] Rumatowski K., Podstawy regulacji automatycznej, Wydawnictwo Politechniki Poznańskiej, Poznań 2008.
[4] Bogdanienko J., Odnawialne źródła energii, Biblioteka problemów, PWN, Warszawa
[5] Smolec W., Fototermiczna konwersja energii słonecznej, PWN, Warszawa 2000
[6] Takahashi Y., Rabins M., Auslander D., Sterowanie i systemy dynamiczne, WNT, Warszawa 1976.
[7] Kaczorek T., Teoria sterowania i systemów, PWN, Warszawa 1999.

SECONDARY LITERATURE:

[1] Kundur P., Power System Stability and Control. McGraw-Hill, Inc.1994.
[2] Nabagło T., Brandys P., Koncepcja sterowania cyfrowego nadążnego układu kolektorów słonecznych, Czasopismo Techniczne. Mechanika, 2011, R. 108, z. 4-M/2, 383-390
[3] Machowski J., Białek J.W., Bumby J.,R., Power system dynamics and stability, John Wiley & Sons New York1997.
[4] Esram T., Chapman P.L., Comparison of Photovoltaic Array Maximum Power Point Tracking Techniques, IEEE Transactions on Energy Conversion, Vol. 22, No. 2, June 2007, pp. 439-449.
[5] Abad G., Lopez J., Rodriguez M.A., Marroyo L, Iwanski G., Doubly Fed Induction Machines. Modeling and Control for Wind Energy Generation, IEE press, A John Wiley & Sons, Inc., Publications.
[6] Qiao W., Zhou W., José M. Aller, and Ronald G. Harley, Wind Speed Estimation Based Sensorless Output Maximization Control for a Wind Turbine Driving a DFIG, IEEE Transactions on Power Electronics, VOL. 23, NO. 3, May 2008.
[7] Mrozek B., Mrozek Z., MATLAB i Simulink. Poradnik użytkownika., Wydawnictwo Helion, 2004.

SUBJECT SUPERVISOR

Daniel Bejmert, daniel.bejmert@pwr.edu.pl