FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Napędy robotów i obrabiarek**
Name in English:	**Drives of robots and machine tools**
Main field of study (if applicable):	**Industrial Control Engineering**
Specialization (if applicable):	
Level and form of studies:	**1st level, full-time**
Kind of subject:	**obligatory**
Subject code:	**APR013209**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30		15		
Number of hours of total student workload (CNPS):	30		30		
Form of crediting:	crediting with grade		crediting with grade		
For group of courses mark (X) final course:					
Number of ECTS points:	1		1		
including number of ECTS points for practical (P) classes :			1		
including number of ECTS points for direct teacher-student contact (BK) classes:	0.70		0.70		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Has a basic knowledge on the robots construction, programming and applications.
2. Has a basic knowledge in the field of electrical machines and drives.
3. Has a basic on kinematics and dynamics of robots.
4. Is able to use the obtained knowledge on electrical machines and drives.
5. Is able to use the obtained knowledge on basic control theory.

SUBJECT OBJECTIVES

C1. Familiarizing students with the issues of construction and operation of modern drives applied in robots and machine tools.
C2. Familiarizing students with the basics of exploitation of robots and machine tools drives.
C3. Gaining skills for testing and performance evaluation of drives of the machine tools, manipulators and industrial robots.
C4. Gaining practical skills for programming of servodrives for machine tools and robots and adjustment of position control systems.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01	Can choose, recognize and characterize basic electrical machines and drives for robots and machine tools
PEU_W02	Knows and understands principles of operation the basic control structures used in robots and machine tools

relating to skills:

PEU_U01	He can perform basic research drives of robots and machine tools and their action program
PEU_U02	Can choose the robot type and its equipment, define its functional requirements depending on specific industrial process.

relating to social competences:

PEU_K01	He understands the need to work in a team and taking care of safety on robotic workstations

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Classification of drives in tool machines and robots. Basic requirements and parameters of servodrives.	2
Lec 2	Characteristic of main and supporting drives in machine tools	2
Lec 3	Electrical motors used in servodrives; DC motors, PM BLDC and PMSM motors, induction motors, step motors; main parameters and requirements.	2
Lec 4	Position control: basic requirements, speed and position controllers, parameter adjustment, dynamical properties of the control loop -part 1	2
Lec 5	Position control: basic requirements, speed and position controllers, parameter adjustment, dynamical properties of the control loop -part 2	2
Lec 6	Servodrives with DC motors; cascade control structure, optimization of dynamical performance	2
Lec 7	Servodrives with induction motors: basics of vector control methods, control structures and examples industral solutions	2
Lec 8	Servodrives with BLDC motors: basics control methods and structures	2
Lec 9	Servodrives with PMSM motors: basics of vector control methods and structures	2
Lec 10	Servodrives with step motors; control methods and structures	2
Lec 11	Hydraulic and pneumatic servodrives - fundamentals of operation	2
Lec 12	Digital servodrives	2
Lec 13	Designing servodrives	2
Lec 14	Overview of chosen technical solutions of industrial drives for CNC machines and robots - development trends	2
Lec 15	Assessment - colloquium	2
	Total hours:	**30**

Form of classes - laboratory		**Number of hours:**
Lab 1	Introduction, basic safety requirements in laboratory. Introduction to the multi-axes position drives with PMSM based on Mitsubishi solutions in robots and CNC machines.	2
Lab 2	Analysis and programming of the arm robots RV-3SB and RV-2AJ	2
Lab 3	Analysis and programming of the SCARA robot based on the RP-1AH robot	2
Lab 4	Analysis and programming of the arm robots RV-3SB	2
Lab 5	Analysis and programming of the cartesian robots	2
Lab 6	Analysis and programming of spindle drive and supporting drive system for machine tools in the CNC Control MPL laboratory set-up	2
Lab 7	Analysis of operation and programming of CNC milling machines	2
Lab 8	Mobil robots. Laboratory assessment	1
	Total hours:	**15**

TEACHING TOOLS USED
N1. Lecture with multimedia tools combined with classical lecture (problem oriented)
N2. Consultation
N3. Final test
N4. Preparation to the laboratory exercises and testing of student knowledge and reports

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	Participation in the lectures.
F2(W)	PEU_W01 PEU_W02	Assessment with grade - colloquium.
P(W)	P=0,1*F1+0,9*F2	
F1(L)	PEU_U01 PEU_U02 PEU_K01	Activity diuring labooratory exercises
F2(L)	PEU_U01 PEU_U02 PEU_K01	Preparation of the raport
P(L)	P=0,3*F1+0,7*F2	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Kosmol J., Serwonapędy obrabiarek sterowanych numerycznie, WNT Warszawa 1998
[2] Kosmol J., Napędy mechatroniczne, Wydawnictwo Politechniki Śląskiej, Gliwice 2013
[3] Pritschow G., Technika sterowania obrabiarkami i robotami przemysłowymi, Oficyna wydawnicza PWr, Wrocław 1995
[4] Honczarenko J., Roboty przemysłowe. Budowa i zastosowanie, WNT Warszawa 2010
[5] Honczarenko J., Obrabiarki sterowane numerycznie,WNT Warszawa 2008

SECONDARY LITERATURE:

[1] Kaczmarek T., Napęd elektryczny robotów, Wydawnictwo Polit. Poznańskiej, 1996
[2] Orłowska-Kowalska T., Bezczujnikowe sterowanie układów napędowych z silnikami indukcyjnymi, Oficyna Wyd. P.Wr. 2003
[3] Zawirski K., Deskur J., Kaczmarek T., Automatyka Napędu Elektrycznego, Wydawnictwo Politechniki Poznańskiej, Poznań 2012

SUBJECT SUPERVISOR

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