

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): **Control Engineering and Robotics**  
 Specialization (if applicable):  
 Level and form of studies: **1st level, full-time**  
 Kind of subject: **obligatory**  
 Subject code: **ARR043209**  
 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 EDUCATIONAL EFFECTS***relating to knowledge:*

- PEK\_W01 Can choose, recognize and characterize basic electrical machines and drives for robots and machine tools  
 PEK\_W02 Knows and understands principles of operation the basic control structures used in robots and machine tools

*relating to skills:*

- PEK\_U01 He can perform basic research drives of robots and machine tools and their action program  
 PEK\_U02 Can choose the robot type and its equipment, define its functional requirements depending on specific industrial process.

*relating to social competences:*

- PEK\_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 industrial 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:		<b>30</b>

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:		<b>15</b>

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 EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation <i>F - forming (during semester)</i> <i>P - concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(W)	PEK_W01 PEK_W02	Participation in the lectures.
F2(W)	PEK_W01 PEK_W02	Assessment with grade - colloquium.
P(W)	$P=0,1 \cdot F1 + 0,9 \cdot F2$	
F1(L)	PEK_U01 PEK_U02 PEK_K01	Activity during laboratory exercises
F2(L)	PEK_U01 PEK_U02 PEK_K01	Preparation of the report
P(L)	$P=0,3 \cdot F1 + 0,7 \cdot F2$	

## 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., Bezczylnikowe 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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### MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT ARR043209 - Drives of robots and machine tools AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Control Engineering and Robotics**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)	Subject objectives	Programme content	Teaching tool number
PEK_W01	K1AiR_W34	C.1 C.2 C.3 C.4	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1 N.2
PEK_W02	K1AiR_W34	C.1 C.2 C.3 C.4	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.2 N.3
PEK_U01	K1AiR_U30	C.1 C.2 C.3 C.4	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.4
PEK_U02	K1AiR_U30	C.1 C.2 C.3 C.4	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.4
PEK_K01	K1AiR_K02 K1AiR_K03	C.1 C.2 C.3 C.4	Lab1 Lab2 Lab3 Lab4 Lab5 Lab6 Lab7 Lab8	N.4