

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Automatyka napędu elektrycznego-podstawy**  
 Name in English: **Controlled Electrical Drives - fundamentals**  
 Main field of study (if applicable): **Electrical Engineering**  
 Specialization (if applicable):  
 Level and form of studies: **1st level, full-time**  
 Kind of subject: **optional**  
 Subject code: **ELR043207**  
 Group of courses: **NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU):	30				
Number of hours of total student workload (CNPS):	120				
Form of crediting:	examination				
For group of courses mark (X) final course:					
Number of ECTS points:	4				
including number of ECTS points for practical (P) classes:					
including number of ECTS points for direct teacher-student contact (BK) classes:	2.80				

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

- Has a matured knowledge in the field of commonly used electrical machines and basics of the drive systems.
- Has a knowledge on the methods of mathematical description, stability analysis methods and dynamical properties of linear and nonlinear control systems.

**SUBJECT OBJECTIVES**

- C1. Familiarizing students with the basic methods and structures of controlled converter-fed DC motor drives and their practical realization.
- C2. Familiarizing students with the basic methods and structures of scalar and vector controlled converter-fed AC motor drives and their practical realization.

**SUBJECT EDUCATIONAL EFFECTS***relating to knowledge:*

- PEK\_W01 Has matured knowledge on control methods and basic structures of DC motor.
- PEK\_W02 Has matured knowledge on control methods and basic structures of induction motor drive and brushless DC and AC motors with permanent magnets.
- PEK\_W03 Can define and describe basic control methods and structures for DC motors, induction motors, brushless DC and AC motors, and characterize their performance.

*relating to skills:**relating to social competences:*

- PEK\_K01 Understands the need for continuous life-long learning and qualifications improving (including II and III level university studies).

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours:
Lec 1	Introduction, the main goal of the lecture, credit requirements. Classification of the control structures for electrical drives. Static and dynamical optimization of the drive systems.	2
Lec 2	Basic torque control structures of electrical motors.	2
Lec 3	Methods of adjustment of linear controllers for electrical drives: integral criteria, modulus and symmetry criteria.	2
Lec 4	Influence of the control mode to the dynamical performance of the DC motor. Operation with constant and variable excitation flux.	2
Lec 5	Cascade and parallel speed control structure of the DC motor drive. Controllers' adjustment, dynamical performances obtained in both control structures. Comparison. Part 1.	2
Lec 6	Cascade and parallel speed control structure of the DC motor drive. Controllers' adjustment, dynamical performances obtained in both control structures. Comparison. Part 2.	2
Lec 7	Induction motor – mathematical model using vector representation, state equations, equivalent circuit in vector form.	2
Lec 8	Influence of the control method to the static characteristic of the induction motor.	2
Lec 9	Frequency controlled induction motor drives – torque control methods of the induction motor.	2
Lec 10	Methods and structures of the field-oriented control (FOC) of an induction motor; control idea, flux and torque control structure, basic problems of practical realization.	2
Lec 11	Methods and structures of the direct torque control (DTC) of an induction motor; control idea, flux and torque control structure, basic problems of practical realization.	2
Lec 12	Scalar control methods with constant flux and constant slip frequency.	2
Lec 13	Frequency control methods for permanent magnet motors – control of BLDC motor; control idea, speed control structure, performance and applications.	2
Lec 14	Frequency control methods for permanent magnet synchronous motors – control of PMSM drive; vector control idea, speed and torque control structure, performance and applications.	2
Lec 15	Trends and developments in controlled electrical driver – sensorless control, intelligent control.	2
Total hours:		<b>30</b>

TEACHING TOOLS USED
N1. Lecture with multimedia tools combined with classical lecture (problem oriented).
N2. Consultations.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation <i>F – forming (during semester) P – concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(w)	PEK_W01 PEK_W02 PEK_W03 PEK_K01	Participation in lectures.
F2(w)	PEK_W01 PEK_W02 PEK_W03 PEK_K01	Final exam.
P(w)	$P=0,1 \cdot F1 + 0,9 \cdot F2$	

PRIMARY AND SECONDARY LITERATURE
<b>PRIMARY LITERATURE:</b> [1] Kaźmierkowski M.P., Tunia H., Automatyka napędu przekształtnikowego. PWN, 1987 [2] Orłowska-Kowalska T., Bezczylnikowe układy napędowe z silnikami indukcyjnymi. Oficyna Wydawnicza P.Wr., Wrocław, 2003 [3] Zawirski K., Deskur J., Kaczmarek T., Automatyka napędu elektrycznego, Wyd. Polit. Poznańskiej, 2012 [4] Orłowska-Kowalska T., Automatyka napędu elektrycznego - podstawy. Oficyna Wydawnicza P.Wr., Wrocław, w druku <b>SECONDARY LITERATURE:</b> [1] Napęd elektryczny, praca zbiorowa pod red. Z. Grunwalda, WNT, 1987 [2] P.Vas, Sensorless Vector and Direct Torque Control, Oxford University Press, 1998 [3] J.M.D.Murphy, F.G.Turnbull, Power Electronic Control of AC Drives, Pergamon Press, Oxford, 1988 [4] W. Leonhard, Control of Electrical Drives, Springer Verlag, 1990

SUBJECT SUPERVISOR
Teresa Orłowska-Kowalska, teresa.orlowska-kowalska@pwr.edu.pl

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT  
**ELR043207 - Controlled Electrical Drives - fundamentals**  
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Electrical Engineering**

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	K1ETK_ETP_W10	C.1	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6	N.1 N.2
PEK_W02	K1ETK_ETP_W10	C.2	Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1 N.2
PEK_W03	K1ETK_ETP_W10	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1 N.2
PEK_K01	K1ETK_K04	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15	N.1