

FACULTY OF ELECTRICAL
ENGINEERING**SUBJECT CARD**

Name in Polish: **Napęd elektryczny**
 Name in English: **Electrical Drive**
 Main field of study (if applicable): **Electrical Engineering**
 Specialization (if applicable):
 Level and form of studies: **1st level, full-time**
 Kind of subject: **obligatory**
 Subject code: **ELR053203**
 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):	60		60		
Form of crediting:	crediting with grade		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

- Has a basic knowledge in the field of electrical machines, their construction, way of operation, knows equivalent schemes, mathematical models and basic characteristics of DC and AC motors.
- Has a basic knowledge on the basic low voltage apparatus, their parameters and applications indifferent electrical systems.
- Has a basic knowledge on description of linear control systems, their performance and analysis.
- Is able to use the knowledge of differential and integral calculus in the problems connected with the engineering studies.
- Can solve the problems related to the analysis of linear controlled systems; knows how to use the proper mathematical methods for time-domain analysis of controlled plants.
- Is able to use the known measurement methods to connect, put into the operation and test the designed measurement system, can analyze and evaluate the measurement results.
- Understands the necessity of taking part in student laboratories and exercises to obtain new knowledge and skills.

SUBJECT OBJECTIVES

- Familiarizing students with the basic problems of steady-state and dynamics of electrical drives.
- Familiarizing students with the basic DC and AC motor drives and speed shaping methods in various operation conditions.
- Gaining skills for understanding, interpretation and analysis of steady state and dynamical performance of basic electrical drives.
- The acquisition of practical knowledge and skills for connection, putting into operation and testing of the electrical motor drives and elaboration of their static and dynamical characteristics.
- Familiarizing students with application of previously known measurement techniques for testing of the DC and AC motor drives.
- Acquisition and fixing the social competences related to work in teams, solving engineering problems together; responsibility, honesty and fairness, observance of manners which are obligatory for academia and society.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

- PEU_W01 Has matured knowledge on basics of the DC and AC motor drives and their operation modes.
- PEU_W02 Can define and describe basic elements of converter-fed electrical drives and can describe and characterize basic speed shaping methods of the DC and AC motors in open and closed-loop systems, in various operation modes.

relating to skills:

- PEU_U01 Can choose the suitable low voltage electric apparatus for given electrical drive of different power.
- PEU_U02 Can realize the measurements of static and dynamical characteristics of different DC and AC electrical drive.

relating to social competences:

- PEU_K01 Student can act independently and cooperate within a group working on a complex engineering project.

PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Introduction, the main goal of the lecture, credit requirements. Electrical drive system - basic definition, components, steady state characteristics of different types of motors and loading machines.	2
Lec 2	Regions of operation of a drive system. Motion equation of electrical drive system, static and dynamic states, stable steady-state operation condition.	2
Lec 3	Influence of different types of mechanical connections to equation of motion.	2
Lec 4	Basic rules of electrical motor choice depending on different load types.	2
Lec 5	DC motor with separate excitation - equivalent circuit, dynamical equations, main and disturbance transfer functions, dynamical performance.	2
Lec 6	DC motor drive systems: speed control methods, starting and braking methods.	2
Lec 7	Forming of DC motor characteristics using different feedbacks.	2
Lec 8	Speed and torque control of the DC motor in the cascade control structure. One and two-directional converter fed DC drive systems.	2
Lec 9	Induction motor drives - methods of speed control, braking methods and their technical realization; principles, basic schematic diagrams, modes of operation, control and mechanical characteristics.	2
Lec 10	Frequency scalar speed and torque control method of the induction motor drive, basics of vector control methods.	2
Lec 11	Speed control methods of wound-rotor induction motors; constant torque and constant power cascade systems.	2
Lec 12	Starting systems for squirrel-cage induction motors; starting methods, basic schemes and mechanical characteristics.	2
Lec 13	Starting systems for wound-rotor induction motors; starting methods, basic schemes and mechanical characteristics.	2
Lec 14	Electrical drives with permanent magnet synchronous motors. Future trends in electrical drive systems.	2
Lec 15	Colloquium - assessment with grade.	2
Total hours:		30

Form of classes - laboratory		Number of hours:
Lab 1	Introduction, presentation of the laboratory stands and safety requirements. Repetition the basic rules of application of analog and digital measurement devices.	1
Lab 2	Kształtowanie charakterystyk silnika obcowzbudnego prądu stałego w różnych stanach pracy. Sterowanie prędkością przy zasilaniu z nawrotnego prostownika sterowanego.	2
Lab 3	Testing of the electrical drive with DC series motor. Testing of DC series motor drive controlled by DC chopper.	2
Lab 4	Testing of the electrical starting systems for the squirrel-cage and wounded-rotor induction motors.	2
Lab 5	Testing of the induction motor drive supplied form the voltage inverter - scalar control, vector control.	2
Lab 6	Testing of the induction motor cascade drive system of constant power.	2
Lab 7	Testing of the induction motor cascade drive system of constant torque.	2
Lab 8	Additional term. Assesment of the laboratory with grade.	2
Total hours:		15

TEACHING TOOLS USED

- N1. Lecture with multimedia tools combined with classical lecture (problem oriented).
 N2. Consultations.
 N3. Laboratory exercises in student groups; testing of student knowledge with short test before laboratory exercises.
 N4. Assessment of the laboratory exercises by reports.

EVALUATION OF SUBJECT LEARNING OUTCOMES 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)	PEU_W01 PEU_W02	Participation in lectures.
F2(W)	PEU_W01 PEU_W02	Test.
P(W)	$P=0,1 \cdot F1 + 0,9 \cdot F2$	
F1(L)	PEU_U01 PEU_U02 PEU_K01	Activity during laboratory exercises (including grades obtaining during short tests).
F2(L)	PEU_U01 PEU_U02 PEU_K01	Preparation of the report.
P(L)	$P=0,3 \cdot F1 + 0,7 \cdot F2$	

PRIMARY AND SECONDARY LITERATURE**PRIMARY LITERATURE:**

- [1] Napęd elektryczny, praca zbiorowa pod red. Z. Grunwalda, WNT, 1987
 [2] Napęd elektryczny – laboratorium, praca zbiorowa pod red. T. Orłowskiej-Kowalskiej, Oficyna Wyd. P.Wr., 2000

SECONDARY LITERATURE:

- [1] W. Leonhard, Control of Electrical Drives, Springer Verlag, 1990

SUBJECT SUPERVISOR

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