STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Foundations of electrical drives		**1010331241010330053**
Field of study	Profile of study (general academic, practical)	Year /Semester
Automatic Control and Robotics	**general academic**	**2 / 4**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**obligatory**
Cycle of study:	Form of study (full-time,part-time)	
First-cycle studies	**full-time**	
No. of hours		No. of credits
Lecture: **30** Classes: **-** Laboratory: **-** Project/seminars: **-**		**3**
Status of the course in the study program (Basic, major, other)	(university-wide, from another field)	
basic	**from field**	
Education areas and fields of science and art		ECTS distribution (number and %)

Responsible for subject / lecturer:

dr hab. inż. Tomasz Pajchrowski
email: tomasz.pajchrowski@put.poznan.pl
tel. 61 6652385
Faculty of Electrical Engineering
ul. Piotrowo 3A 60-965 Poznań

Responsible for subject / lecturer:

dr hab. inż. Tomasz Pajchrowski
email: tomasz.pajchrowski@put.poznan.pl
tel. 61 6652385
Faculty of Electrical Engineering
ul. Piotrowo 3A 60-965 Poznań

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student should have knowledge in chosen branches of physics including the electricity and the magnetism and the knowledge of the theory of electric circuits.
2	**Skills**	Student is able to obtain information from literature, databases and other sources; has abilities of the self-education for improving qualifications and the update of professional competence
3	**Social competencies**	Student is aware of a need to expand his competence and readiness to undertake the cooperation in the team; has an awareness of the importance and understands other aspects of engineering activity, including its influence on the environment

Assumptions and objectives of the course:

-Getting knowledge of building, operation and characteristics of the basic drives with converters

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. The student has a knowledge tidied up in the structure, the application and control of the automation and robotics systems - [K_W19++]

2. Student knows and understands typical engineering technologies, knows and understands principles of the selection of servo- and measuring-testing devices - [K_W20++]

Skills:

1. Student is able to use models of simple electromechanical systems, as well as to use them for analysis and design automations and robotics systems - [K_U05+++]

2. Student is able to select the kind and parameters of servo- and measuring system, control unit for the chosen application and to effect their integration in the form of the ultimate measuring-control system - [K_U17++]

Social competencies:

1. Student has an awareness of the need for the professional approach towards technical issues, of meticulous acquainting oneself with documentation and environmental conditions, in which devices and their elements can function - [K_K04++]]

Assessment methods of study outcomes

Passing the lecture is written and oral examination. Laboratory exercises are counted independently from the lecture, based on attendance and activity in the class and reports (one per exercise group).

Course description

-The study presents theory in close association with practice. Presenting a new topic is preceded by a reminder of related content known to students from other subjects. Program contents: Drive dynamics equation, mechanical characteristics, work in individual quadrants, characteristics of driven devices, torque and moment of inertia reduction to the motor shaft, including losses in the drive components.

Equation of heat balance of electric machine.

Standardized types of electric machine operation, continuous operation S1, selection of a continuous drive motor for constant load driving and repeated cycle of varying load, medium loss, replacement, replacement and replacement power.

Drives with induction motors: construction of annular and cage motor, alternate phase diagram of ring motor and its mechanical characteristics, model of Kloss, interpretation of name plate data and determination of Kloss parameters based on them, operating conditions of induction motor, mechanical characteristics of conventional cage engines, deep direct-current, resistive, soft-start, with star-delta switch, rotational speed control of induction motors: resistive, by stator voltage change, frequency (two zones and control limitation), by changing the number of pole pairs, by means of additional rotor circuit voltage (cascade cascade).

DC drives: equation and DC machine characteristics, continuous current limiting, thyristor DC drive unidirectional and reversing, symmetrical and non-inverter inverter interrupt protection, transistor DC drive with pulse transformer: single quadrant, two quadrant and quadrant .

Synchronous machine motors: angular torque characteristics and two components thereof, synchronous power supply from direct frequency converter (cycloconverter), characteristics and properties of synchronous motor powered by inverter controlled by rotor position (converter motor), permanent magnet synchronous motor properties in vector control.

Actuators with stepper motors: angular torque characteristic, torque versus pulse, full-step and fractional-step work, angular speed conversion to pulse frequency, stepping motor selection principle.

Lab. Detailed review of the reports by leading labs and commentary discussions. Form of classes: Programming and team work. Program content: Parameters, characteristics and operating conditions of the induction and direct current machine, thyristor direct current drive, transistor DC drive, induction motor starting methods, cage engine frequency control, electric machine heat conditions, fan drive.

Basic bibliography:

1. Drozdowski P.: Wprowadzenie do napędów elektrycznych. Skrypt Politechniki Krakowskiej, Kraków 1998

2. Sidorowicz J. Napęd elektryczny i jego sterowanie. Oficyna Wydawnicza Politechniki Warszawskiej 1994

3. Kaczmarek T.: Napęd elektryczny robotów, wyd.2, Wydawnictwo Politechniki Poznańskiej, Poznań 1998.

Additional bibliography:

1. Tunia H., Kaźmierkowski M.P.: Automatic Control of Converter-fed Drives, Elsevier Amsterdam ? London ? New York ? Tokyo, PWN Warszawa 1994

2. Dewan S. B., Slemon G. R., Straughen A.: Power Semiconductor Drives. John Wiley & Sons, New York, Chichester, Brisbane, Toronto, Singapore 1984

Result of average student's workload

Activity	Time (working hours)
1. Participation in the lecture	30
2. Consultation	2
3. Preparation for examination	25
4. Participation in examination	3

Student's workload

Source of workload	hours	ECTS
Total workload	60	3
Contact hours	45	0
Practical activities	0	0