STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Electromechanical Propulsion Systems		**1010322321010325452**

Field of study	Profile of study (general academic, practical)	Year /Semester
Electrical Engineering	**(brak)**	**1 / 2**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
Second-cycle studies	**full-time**

No. of hours					No. of credits
Lecture: **15**	Classes: **-**	Laboratory: **15**	Project/seminars: **-**		**2**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
(brak)	**(brak)**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**2 100%**
Technical sciences	**2 100%**

Responsible for subject / lecturer:

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Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Basic knowledge in the area of theory, characteristics and the method of electrical machine control.
2	**Skills**	Matrix calculus on the basic level. Ability of the effective self-education in the field associated with chosen subject.
3	**Social competencies**	The student is aware of a need to expand its competence, readiness to undertake the cooperation in the team.

Assumptions and objectives of the course:

The student should obtain knowledge of the mathematical models of induction and synchronous machines, as well as the brushed and brushless direct current motors.

Getting knowledge about modern algorithms of vector control of induction motor and optimal control of the synchronous motor. Understanding of the principles of operation of regulated driving systems

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

Knowledge:

1. Student has a knowledge about developmental trends and the most significant new achievements in the electrical engineering, electronics, computer science and energetics. - [K_W04 +]

2. Student has a knowledge about formulating equations describing simple driving systems, principles of the identification and using computer simulations software; has a knowledge in the scope of designing simple driving systems - [K_W10 +++]

3. Student has a knowledge in the possibility and restrictions of methods used in CAD in the area of electrical engineering - [K_W18 +]

Skills:

1. Student is able to work individually and in the team, is able to assess tasks the time consumption; is able to manage the small team in the way guaranteeing the completion of setting in the established time - [K_U02 ++]

2. Student is able to draw up detailed documentation of results of the experiment, of design or research task; - [K_U03 ++]

3. Student is able to assess the possibility of using new technological achievements for the design and productions of the electrical devices and systems, containing innovative solutions - [K_U19 ++]

Social competencies:

1. The student understands the need of formulating both handing over to the society information and opinions of achievements in the area of electrical engineering and other aspects of activity of an electrical engineer - [K_K02 ++]

Assessment methods of study outcomes

Lecture:

- constant judging on every classes (awarding a bonus to the activity and qualities of the perception),
- evaluation of the knowledge and abilities on a written problem character examination.

Laboratory:

- the test and awarding a bonus to the essential knowledge of problems for the accomplishment stated in given area of laboratory tasks,
- constant judging, on every classes - awarding a bonus to the increase in the ability of using with found principles and methods,
- the evaluation of the knowledge and the abilities associated with the accomplishment of the exercise task, the evaluation of the report from the performed exercise.

Getting additional points for the activity during classes, particularly for:

- proposing discussing additional aspects of the issue,
- ability of the cooperation in the team performing the task in the laboratory;
- remarks about improving teaching materials.
- quality of the elaborated reports.

Course description

Circuit models of induction machine, voltage equation in natural coordinate frame. Two-axis model of induction machine, transformation of impedance matrix. Equilibrium equations for drive with induction motors: steady state and transients. Scalar and field-vector control of induction motor drives Magnetic circuits. Equations of synchronous machines. Converter fed motor. Drives with stepping motors. Brushes DC motors and universal motors. Drives with brushless DC motors. Structures of control systems for electric drives.

Applied methods of education:

Lectures:

- lecture with multimedia presentation supplemented with examples given on the board,
- interactive lecture with questions to students,
- student activity is taken into account during the course of the assessment process.

Laboratory:

- detailed review of the reports by the teacher, discussion,
- demonstrations and presentations,
- teamwork.

Basic bibliography:

1. Wykłady z elektromechanicznych przemian Energii, Sobczyk T., Węgiel T., Wydawnictwo Politechniki Krakowskiej, Kraków 2014
2. Zasady elektromechanicznego przetwarzania energii (tłum. z angielskiego), Meisel J., Wydawnictwo Naukowo Techniczne, Warszawa, 1970.
3. Napęd elektryczny i jego sterowanie, Sidorowicz J., Oficyna Wydawnicza Politechniki Warszawskiej , Warszawa, 1994.
4. Electrical drivers and electromechanical systems, Crowder R., Elsevier, 2006.
5. Dynamics and Control of Electrical Drivers, Wach P., Springer Verlag, Berlin-Heidelberg, 2011.
6. Permanent magnet and Electromechanical Devices, Furlani E.P., Academic Press, 2001.
7. Wprowadzenie do napędów elektrycznych, Drozdowski P., Skrypt Politechniki Krakowskiej, Kraków, 1998.

Additional bibliography:

1. Sterowanie silnikiem synchronicznym o magnesach trwałych, K. Zawirski, Wydawnictwo Politechniki Poznańskiej, Poznań, 2005.
2. Bezczujnikowe układy napędowe z silnikami indukcyjnymi, Orłowska-Kowalska T., Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2003.
3. Automatyka napędu elektrycznego, Deskur J., Kaczmarek T., Zawirski K., Wydawnictwo Politechniki Poznańskiej, Poznań 2012.

Result of average student's workload

Activity	Time (working hours)

1. Participation in the lecture	15
2. Participation in the laboratory exercises	15
3. Participation in the consultation	7
4. Participation in the examination	2
5. Preparing for the examination	10
6. Preparing for the laboratory exercises and carrying reports out	11

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	60	2
Contact hours	39	1
Practical activities	28	1