STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Electromechanical Propulsion Systems**		Code **1010322311010325452**
Field of study **Electrical Engineering**	Profile of study (general academic, practical) **general academic**	Year /Semester **1 / 1**
Elective path/specialty **-**	Subject offered in: **Polish**	Course (compulsory, elective) **obligatory**
Cycle of study: **Second-cycle studies**	Form of study (full-time,part-time) **full-time**	
No. of hours Lecture: **30** Classes: **15** Laboratory: **-** Project/seminars: **-**		No. of credits **3**
Status of the course in the study program (Basic, major, other) **major**	(university-wide, from another field) **from field**	
Education areas and fields of science and art **technical sciences** **Technical sciences**		ECTS distribution (number and %) **3 100%** **3 100%**

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 about electrical and magnetic circuits. The knowledge of the principles of electrical machines.
2	**Skills**	Differential and integral 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:

Getting the knowledge in the methods of calculation of integral parameters of electromagnetic systems and getting the ability of analysis and design of electromagnetic actuators and electrical motors. Practical taking control of principles of formulating and solving equations of dynamics of electromechanical systems. Strengthening abilities of the selection of elements of driving systems in different operation modes.

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 use methods and mathematical models for analysis and designing electrical devices and systems - [K_U06 ++]
2. Student is able to compare design solutions and production processes in respect to functional and economic criteria - [K_U08 +]
3. Student is able to plan the process of testing assembled electrical devices and systems - [K_U10 ++]
4. 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, rating students.

Classes:

?the test and awarding a bonus to the essential knowledge for stated implementations of problems in the given area of theoretical tasks,

?constant judging, on every classes - awarding a bonus to the increase in the ability of using with found principles and methods.

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

?proposing discussing additional aspects of the issue,

?effectiveness of applying the acquired knowledge while solving a set problem,

?remarks about improving teaching materials.

?drawing up individual test and design tasks.

Course description

Magnetic circuits. Non-linear and variable structure circuits. Sommerfeld theory: energy and co-energy. Analogies of electrical, magnetic and mechanical systems. Electromagnetic forces and torques ? virtual work principle. Forces in linear and non-linear systems. Forces in alternating current circuits. Mechanical system dynamics: the Hamilton?s principle and Lagrange?s equations. Unified coordinates; unified energy and co-energy. Lagrange equations for electromechanical systems. Linear movement electromagnetic actuators: basic structures; the steady-state characteristics and dynamics. Heating of electrical devices. Electrical machines operation modes. Reducing transmission gears. The electric motor as the element of the automatic control system. General structure of the automatic control drive system. The circuits models: natural and transformed current coordinates. Transformation of multi-phase systems. Transformation of the rotary systems. The symmetrical components model.

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.

Classes:

- solving example tasks on the board,

- a detailed review of the exercise by the teacher, discussion.

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	30
2. Participation In classes	15
3. Participation in consultation	10
4. Preparing for classes	20
5. Accomplishment of design tasks	10

Student's workload

Source of workload	hours	ECTS
Total workload	85	3
Contact hours	50	2
Practical activities	0	0