COURSE DESCRIPTION CARD - SYLLABUS

Course name

Electromechanical Propulsion Systems

Course

Field of study

Aviation

Year/Semester

3 / 5

Area of study (specialization)

Aircraft engines and airframes

Profile of study

general academic

Level of study

First-cycle studies

Course offered in

english

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

30

Laboratory classes

15

Other (e.g. online)

Tutorials

Projects/seminars

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

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Prerequisites

A student starting this subject should have basic knowledge in mathematics, including algebra, analysis and theory of differential equations necessary to describe electrical machines and propulsion systems as well as knowledge in physics, covering the fundamentals of classical mechanics, electricity and magnetism, thermodynamics necessary to understand phenomena in electromechanical propulsion systems. In terms of skills a student starting this subject should have the ability to self-study with the use of modern teaching tools, such as remote lectures, websites and databases, teaching programs and international literature on modern propulsion systems and should be skilled to create simple diagrams

and connect electrical circuits. In terms of social competences a student starting this subject should understand the need for critical assessment of knowledge and continuous learning, as well as understand the principles of cooperation during research in laboratories.

Course objective

Understanding the construction, operating principles, characteristics, operational properties and basic methods of analysis and laboratory tests of the aircraft generators and the aircraft propulsion systems, including mechatronic systems and automation executive systems, in particular electromechanical converters included in these systems. An indication of the direction of efforts aimed at introducing new "MEA" technologies in the aviation industry.

Course-related learning outcomes

Knowledge

1. has extended and in-depth knowledge of mathematics including algebra, analysis, theory of differential equations, probability, analytical geometry as well as physics covering the basics of classical mechanics, optics, electricity and magnetism, solid state physics, thermodynamics, useful for formulating and solving complex technical tasks related to engineering aeronautical and modeling

2. has basic knowledge of the generation and processing of signals in the form of currents, electric voltages and electromagnetic fields

3. has detailed knowledge related to selected issues in the field of construction of aircraft propulsion systems and the design of their components as well as their life cycles and principles of technical description

Skills

1. is able to obtain information from various sources, including literature and databases, both in Polish and in English, integrate them properly, interpret them and make a critical evaluation, draw conclusions and exhaustively justify the opinions they formulate

2. is able to properly plan and perform experiments, including measurements and computer simulations, interpret the obtained results, and correctly draw conclusions from them

3. can analyze objects and technical solutions, can search in catalogs and on manufacturers' websites, ready components of machines and devices, including means and devices, assess their suitability for use in their own technical and organizational projects

Social competences

1. understands that in technology, knowledge and skills very quickly become obsolete

2. is aware of the importance of knowledge in solving engineering problems and knows examples and understands the causes of faulty engineering projects that have led to serious financial and social losses, or to a serious loss of health and even life

3. is aware of the social role of a technical university graduate, in particular understands the need to formulate and provide the society, in an appropriate form, with information and opinions on engineering activities, technological achievements, as well as the achievements and traditions of the engineer profession

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture accepted on the ground of written tests checking knowledge and student classroom activity (test is scored)

Programme content

Aircraft systems for the generation and distribution of electricity and for the conversion of electricity into mechanical energy. Magnetic and electrical circuits in the electromechanical converters: materials for magnetic cores, permanent magnets, windings, insulation materials. Rectifier transformers. Aircraft generators: brushless direct current generators, synchronous and reluctance generators. Electric motors - operating principles and basic characteristics. Induction motors, synchronous motors, DC motors. High-speed machines in aviation. Electric machine heating. Airplane cooling systems. Electric drive systems: load characteristics, power electronics systems, control methods. Generator-starter system. Electromechanical actuators of on-board automation systems. MEA - new technologies in aviation electrical machines, superconducting systems, magnetic levitation systems, electricity storage. Hybrid and electric aircraft.

PART-66

MODULE 4. BASIC NEWS FROM THE FIELD OF ELECTRONICS

4.3 Servomechanism

a) Understanding of the following terms: closed and open circuit system, coupling feedback, further processing, analogue converter; Operating and operating principles of the following components and features of the links synchronous: converters, differentials, control and torque, transformers, capacitance and induction transmitter. [1]

b) Understanding the following terms: closed circuit, open circuit, further processing, servo, analog transducer, zero, attenuation, feedback, zone insensitivity; Construction, operation and use of the following components synchronous: converters, differentials, control and torque, E and I transformers, induction transmitter, capacitance transmitter, transmitter synchronous; Servo faults, synchronous weight reversal, machine swinging synchronous. [-]

MODULE 5. SYSTEMS OF ELECTRONIC INSTRUMENTS OF DIGITAL TECHNIQUES

5.14 Electromagnetic environment

Impact of the following phenomena on technical support of systems electronic: EMC - electromagnetic compatibility; EMI - electromagnetic interference; HARF - field with high radiation intensity; Lightning protection. [2]

5.15 Typical electronic / digital systems on aircraft

General arrangement of typical electronic / digital systems on aircraft and associated BITE (embedded devices testing), such as: a) only for B1 and B2: ACARS-ARINC communication, addressing and reporting system; EICAS - engine indicator systems and crew notification; FBW - electronic artificial stability system [2]

Teaching methods

1. Lecture: multimedia presentation, illustrated with examples on the board.

2. Examples given on the board and performance of tasks given by the teacher according to written istruction - practical exercises.

Bibliography

Basic

1. Wykłady z elektromechanicznych przemian energii, Sobczyk T., Węgiel T., Wydawnictwo Politechniki Krakowskiej, Kraków 2014,

2. Maszyny Elektryczne, W. Przyborowski, G. Kamiński, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2014,

3. Electric Machines: steady-state theory and dynamic performance, M. S. Sarma, West Publishing Company, wyd. 2 1996,

4. Wprowadzenie do napędu elektrycznego, W. Koczara, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2012.

Additional

1. Zagadnienia obliczeniowe w eksploatacji maszyn elektrycznych. P. Staszewski, W. Urbański, Oficyna Wydawnicza, Politechniki Warszawskiej, Warszawa 2009,

2. Poradnik Inżyniera Elektryka, Praca zbiorowa, Tom 2, wyd.3, WNT Warszawa 2009,

3. Automatyka napędu elektrycznego, Deskur J., Kaczmarek T., Zawirski K., Wydawnictwo Politechniki Poznańskiej, Poznań 2012,

4. Recent Advances in Aircraft Technology Edited by Dr. Ramesh Agarwal, ISBN 978-953-51-0150-5, Hard cover, 544 pages, Publisher InTechPublished online 24, February, 2012, Published in print edition February, 2012,

5. J. F. Gieras, Advancements in Electric Machines (Power Systems), USA, NY, New York:Springer-Verlag, 2008.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	4,0
Classes requiring direct contact with the teacher	45	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation)[1]	30	2,0

[1] delete or add other activities as appropriate