COURSE DESCRIPTION CARD - SYLLABUS

Course name

Theory of Propulsion Systems

Course

Field of study

Aviation and Astronautics

Year/Semester

2/3

Area of study (specialization)

Aero engines and airframes

Profile of study

general academic

Level of study

First-cycle studies

Course offered in

polish

Form of study

full-time

Requirements

elective

Number of hours

Lecture

45

Laboratory classes

Other (e.g. online)

Tutorials

30

Projects/seminars

Number of credit points

7

Lecturers

Responsible for the course/lecturer:

dr inż. Robert Kłosowiak

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Wydział Inżynierii Środowiska i Energetyki

ul. Piotrowo 3; 60-965 Poznań

Responsible for the course/lecturer:

Dr inż. Bartosz Ziegler

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Wydział Inżynierii Środowiska i Energetyki

ul. Piotrowo 3; 60-965 Poznań

Prerequisites

The student should have basic knowledge and skills in technical drawing, mechanics, strength of materials, thermodynamics (the concepts of enthalpy, entropy, heat, perfect gas model, basic gas conversions), fluid mechanics (forces exerted by a fluid on a flow channel, flow classification, isentropic flows, viscous phenomena and their impact on the field flow) and aerodynamics (wing and profile aerodynamics, criterion numbers, boundary layer theory, turbulence)

Course objective

Teach the theory of aviation propulsion systems based on flow heat engines (turbine single and double flow jet engines, turboprop engines, jet and rocket engines). In particular, learn the analytical tools

needed for the quantitative analysis of such engines, as well as familiarize yourself with the qualitative relationships between the characteristic parameters

Course-related learning outcomes

Knowledge

1. has basic knowledge of electric drives in machines, including three-phase current, DC and AC motors, frequency and voltage converters, and power electronics. as well as about automation systems, microcontrollers, control algorithms, automatics and industrial robots, electronic navigation systems used in machines and communication systems

2. has ordered, theoretically founded general knowledge covering key issues in the field of technical thermodynamics, i.e. the theory of thermodynamic changes, heat flow, heat and cooling machines

3. has expanded knowledge necessary to understand profile subjects and specialist knowledge about construction, methods of construction, manufacture, operation, air traffic management, safety systems, impact on the economy, society and the environment in the field of aviation and space science for selected specialties Aircraft engines and components airframe

4. student knows and understands the relationship of thermodynamics of a flow engine with its design features. Is able to link this information with design criteria and optimization directions

5. knows and understands the basic concepts and principles in the field of protection of industrial property and copyright and the need to manage intellectual property resources

Skills

1. knows how to use native and international languages to the extent that it is possible to understand technical texts and to write using technical dictionaries machine descriptions in the field of aviation and astronautics (knowledge of technical terminology)

2. is able to obtain information from literature, the Internet, databases and other sources. Is able to integrate the information obtained, interpret and draw conclusions from them as well as create and justify opinions

3. is able to develop a safety instruction for a simple and medium-complex on-board device, machine or technical flying object in specified environmental conditions

4. Is able to implement a 0-dimensional physical model of a flow engine in any computing environment

5. is able to develop a manual and repair instructions for a simple machine or its components from the group of machines covered by the selected specialty

Social competences

1. understands the need for lifelong learning; can inspire and organize the learning process of others

2. is aware of the importance and understands the non-technical aspects and effects of engineering activities, including its impact on the environment, and the associated responsibility for the decisions taken

3. can think and act in an entrepreneurial manner

4. is aware of the responsibility for their own work and readiness to comply with the principles of teamwork and taking responsibility for jointly completed tasks

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:
written exam

final test

Programme content

Turbine engines as a drive for aircraft engines. Requirements, construction and operational requirements for drive units and automatic turbine engine control systems. Examples of practical implementation of control systems of modern turbine engines. Operation of aircraft powered by turbine and piston engines according to standards specified in the requirements of EASA PART 66 aviation regulations.

Physical basics of thrust generation by aircraft drives; The course of gasodynamic parameters along the flow channel of a turbine engine; Quasi-real thermodynamic cycle of a single-flow engine; Influence of flight parameters (speed, altitude) and engine parameters (compression, heating, efficiency of compression and expansion processes, etc.) on unit utilization parameters of the engine (unit thrust, unit fuel consumption, components and general efficiency); Double-flow motors (auxiliary channel circuit, characteristics); Fundamentals of construction and thermodynamic cycles of rocket engines.

Teaching methods

lecture, description, discussion, blackboard exercises, independent practical exercises

Bibliography

Basic

1. Lotnicze silniki turbinowe : konstrukcja - eksploatacja - diagnostyka. Cz. 1Włodzimierz Balicki, Ryszard Chachurski, Paweł Głowacki, Jan Godzimski, Krzysztof Kawalec, Adam Kozakiewicz, Zbigniew Pągowski, Artur Rowiński, Jerzy Szczeciński, Stefan Szczeciński. , Wydawnictwa Naukowe Instytutu Lotnictwa. Wydawca, Wydawnictwa Naukowe Instytutu Lotnictwa, 2010

2. Lotnicze zespoły napędowe. Cz. 2 / Stefan Szczeciński, Włodzimierz Balicki, Ryszard Chachurski, Paweł Głowacki, Jan Godzimirski, Adam Kozakiewicz, Zbigniew Pągowski, Jerzy Szczeciński.Wydawnictwa Naukowe Instytutu Lotnictwa. Wydawca, Wydawnictwa Naukowe Instytutu Lotnictwa,

3.Lotnicze zespoły napędowe. Cz. 3 / Stefan Szczeciński, Włodzimierz Balicki, Ryszard Chachurski, Paweł Głowacki, Krzysztof Kawalec, Adam Kozakiewicz, Jerzy Szczeciński. Wydawnictwa Naukowe Instytutu Lotnictwa. Wydawca, Wydawnictwa Naukowe Instytutu Lotnictwa,

4. Eksploatacja silników turbinowych / Benedykt Boliński, Zdzisław Stelmaszczyk.Wydawnictwa Komunikacji i Łączności. Wydawca

5. Turbinowe silniki odrzutowe / Paweł Dzierżanowski, Walerian Kordziński, Mieczysław Łyżwiński, Jerzy Otyś, Stefan Szczeciński, Ryszard Wiaterek,Wydawnictwa Komunikacji i Łączności. Wydawca Wydawnictwa Komunikacji i Łączności, 1983.

6. Dzierżanowski P. „Turbinowe silniki odrzutowe", Wydawnictwa Komunikacji i Łączności (posiadanie własnego egzemplarza nie jest obowiązkowe. Wykład pokrywa treść w sposób wystarczający)

Additional

Rolls Royce.. The Jet Engine, Renault Printing Co Ltd, Birmingham 1986.

Boyce, Meherwan P.. Gas Turbine Engineering. Butterworth-Heinemann, Waltham, fourth edition, 2012.

Kiameh, Philip.. Power Generation Handbook. McGraw-Hill, New York, 2002.

Breakdown of average student's workload

	Hours	ECTS
Total workload	175	7,0
Classes requiring direct contact with the teacher	85	3,4
Student's own work (literature studies, preparation for laboratory tutorials, preparation for tests/exam) [1]	90	3,6

[1] delete or add other activities as appropriate