



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Theory of unmanned aerial vehicles and aircraft propulsion

### Course

Field of study

Aviation and Astronautics

Area of study (specialization)

Aircraft engines and airframes

Level of study

First-cycle studies

Form of study

full-time

Year/Semester

2/4

Profile of study

general academic

Course offered in

polish

Requirements

elective

### Number of hours

Lecture

30

Laboratory classes

30

Other (e.g. online)

Tutorials

Projects/seminars

### Number of credit points

5

### Lecturers

Responsible for the course/lecturer:

dr inż. Robert Kłosowiak

email: robert.klosowiak@put.poznan.pl

tel. 61 665 23 31

Wydział Inżynierii Środowiska i Energetyki

ul. Piotrowo 3; 60-965 Poznań

Responsible for the course/lecturer:

Dr. Jędrzej Łukasiewicz

email: jedrzej.lukasiewicz@put.poznan.pl

tel. 61 2244511

Wydział Inżynierii Lądowej i Transportu

ul. Piotrowo 3, 60-965 Poznań

### Prerequisites

Basic knowledge of mathematics, chemistry and physics, technical drawing, mechanics, strength of materials and thermodynamics. Using literature (textbooks, internet), ability to perceive lecture content, awareness of the need to deepen engineering knowledge and its place in everyday life

### Course objective

To familiarize students with issues related to the requirements, construction and operation of aircraft assemblies for turbine engines and examples of control systems implementation. Providing students with basic knowledge in the field of flight organization and piloting of unmanned aerial vehicles in the scope specified by the curriculum content relevant to the field of study.



### 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. has basic knowledge in the field of main branches of technical mechanics: statics of kinematics and material point dynamics and rigid body and strength of materials, including the basics of the theory of elasticity and plasticity, strain hypotheses, methods of calculating beams, membranes, shafts, joints and other simple structural elements, as well as methods for testing the strength of materials and the state of deformation and stress in structures

#### 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 create a system diagram, select elements and perform basic calculations of the electrical and electronic systems of aircraft machines or devices
5. knows how to use verbal communication with one additional foreign language at the everyday language level, can describe the issues of the studied field of study in this language, can prepare technical descriptive and drawing documentation of an engineering, transport and / or logistics task

#### 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

### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

written exam

laboratory reports and 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. Construction of unmanned aerial vehicles, aviation law as regards unmanned aerial vehicles, principles of unmanned aerial vehicle operations, flight safety and dangerous situations.

### Teaching methods

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

### Bibliography

Basic

1. Lotnicze silniki turbinowe : konstrukcja - eksploatacja - diagnostyka. Cz. 1 Włodzimierz 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 Godzimski, 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. Drony dla początkujących, Terry Kilby, Belinda Kilby



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   | 125   | 5,0  |
| Classes requiring direct contact with the teacher  | 70    | 1,8  |
| Student's own work (literature studies, preparation for laboratory classes, preparation for tests/exam) <sup>1</sup> | 55    | 1,2  |

<sup>1</sup> delete or add other activities as appropriate