COURSE DESCRIPTION CARD - SYLLABUS

Course name
Theory of aircraft engines [S1Lot2-SLiPL>TSL]

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

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

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

Course objective

Teach the theory of aircraft powertrains based on flow heat engines (turbine jet engines, single and double flow, turboprop engines, ramjet and rocket engines). In particular, teach the analytical tools needed for quantitative analysis of such engines, as well as familiarize with qualitative relations between characteristic parameters

Course-related learning outcomes

Knowledge:
1. has extended and deepened knowledge of mathematics covering 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 aviation engineering and modeling
2. has structured, theoretically based general knowledge in the field of technology and various means of air transport, about the life cycle of means of transport, both hardware and software, and in particular about the key processes occurring in them
3. has structured and theoretically based general knowledge in the field of key issues of technology and detailed knowledge in the field of selected issues related to air transport,
knows the basic techniques, methods and tools used in the process of solving tasks related to air transport, mainly of an engineering nature
4. has structured, theoretically based general knowledge covering key issues in the field of technical thermodynamics, fluid mechanics, in particular aerodynamics
5. has detailed knowledge related to selected issues in the field of construction of manned and unmanned aircraft, in the field of on-board equipment, control systems,
communication and recording systems, automation of individual systems, has basic knowledge of flight simulation training devices and simulation methods used to solve air transport issues
6. has detailed knowledge related to selected issues in the field of construction of aircraft propulsion systems
and design of their components
7. has detailed knowledge related to selected issues in the field of construction of aircraft propulsion systems
and design of their components as well as their life cycles and principles of technical description
8. has the ability to self-educate using modern teaching tools, such as
remote lectures, Internet sites and databases, teaching programs, e-books

Skills:
1. is able to obtain information from various sources, including literature and databases, both in Polish and English,
integrate it properly, interpret it and critically
assess, draw conclusions, and comprehensively justify the opinions they formulate
2. is able to appropriately use information and communication techniques that are applied at various stages of implementing aviation projects
3. is able to solve tasks using basic knowledge of aerodynamics, flight mechanics and flow around bodies
4. is able to design means of transport with appropriate external requirements (e.g. concerning environmental protection)
5. is able to analyze objects and technical solutions, is able to search
catalogs and on manufacturers' websites for ready-made components of machines and devices, including means and devices, assess their suitability for use in their own technical and organizational projects
6. is able to use the language of mathematics (differential and integral calculus) to describe simple engineering issues. 7. is able to organize, cooperate and work in a group, assuming different roles in it and is able to
appropriately define priorities for the implementation of a task defined by himself or others
8. is able to plan and implement the process of his own permanent learning and knows the possibilities of further education (2nd and 3rd degree studies, postgraduate studies, courses and exams conducted by universities, companies and professional organizations)

Social competences:
1. understands that in technology knowledge and skills very quickly become outdated
2. is aware of the importance of knowledge in solving engineering problems and knows examples and understands the causes of malfunctioning engineering projects that led to serious
financial, social losses or serious loss of health or even life
3. is aware of the social role of a graduate of a technical university, in particular understands the need to formulate and communicate to the public, in an appropriate form, information and opinions concerning engineering activities, technical achievements, as well as the achievements and traditions of the engineering profession
4. correctly identifies and resolves dilemmas related to the performance of the profession aerospace engineer

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture (final grade consists of three components):
1. Written assessment/final exam (65%)
2. Assessment of a small group midterm project (20%)
3. Assessment of individual homework (15%)
Classes:
1. Written assessment of computational problems (100%)
To pass the course, it is required to obtain no less than 60% of the component points.
The grading curve for the 60%-100% range is established individually in each semester.

Programme content

Lecture semester I:
Physical basics of thrust generation by aircraft propulsion; Course of gas-dynamic 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 operating parameters of the engine (unit thrust, unit fuel consumption, component and overall efficiency); Double-flow engines (auxiliary channel circuit, characteristics); Basics of design and thermodynamic cycles of rocket engines
Exercises semester I:
Calculation of work of a turbine/jet engine cycle; determination of unit parameters (unit thrust, unit fuel consumption, component and overall efficiency) based on flight parameters and thermodynamic cycle parameters; Calculation of optimal and required compression pressures of compressor units for given flight parameters; Calculation of parameters of component processes of the cycle; Calculation of basic rocket performance based on simplified relationships.
PART - 66 (THEORY - 33.75 hrs. [obsolete 40 hrs.])
MODULE 16. PISTON ENGINE
16.5 Starting and ignition system
Starting systems and preheating systems;
Types of magneto, design and operating principles;
Ignition wire system, spark plug housing;
Low and high voltage systems. [2]
16.6 Intake system, exhaust system and cooling system
Design and operation: intake system including variable air supply systems;
Exhaust system, engine cooling system - air and liquid. [2]
16.11 Propulsion Equipment Installation
Configuration of firewalls, covers, acoustic panels, engine mounts, anti-vibration mounts, cables, pipes, power supplies, connectors, cable harnesses, control cables, control rods, lifting points, and drains. [2]

Course topics

1. Overview and classification of aerospace and space drives
2. Thrust equation, its simplified versions
3. Piston aircraft engine
4. Changes of gas-dynamic parameters along the flow channel of a turbine engine
5. Work of quasi-real cycle of a flow engine
6. Component efficiencies and operating parameters of aircraft drives

Teaching methods

1. Blackboard lecture
2. Auditorium exercises
3. Computational projects performed using publicly available programming tools

Bibliography

Basic:
1. Dzierżanowski P. "Turbine Jet Engines", Wydawnictwa Komunikacji i Łączności (having your own copy is not obligatory. The lecture covers the content sufficiently)
Supplementary

Additional:
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Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	47	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	53	2,00