COURSE DESCRIPTION CARD - SYLLABUS

Course name
Integrated aircraft engine design systems

Course

Field of study	Year/Semester
Aviation	4/7
Area of study (specialization)	Profile of study
Aircraft engines and airframes	general academic
Level of study	Course offered in
First-cycle studies	english
Form of study	Requirements
full-time	elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	15	
Tutorials	Projects/seminars	

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
dr inż. Bartosz Ziegler

bartosz.ziegler@put.poznan.pl

Responsible for the course/lecturer:

Prerequisites

The student should have basic knowledge and skills in mathematics, especially in the field of differential calculus of many variables, vector calculus and linear algebra, in addition thermodynamics, fluid mechanics and aerodynamics as well as knowledge of the subject of aircraft engines theory as well as have basic knowledge and skills in the subject of Integrated Engine Design Systems Aviation - semester 1.

Course objective

- Learn the rules: Expand the knowledge and skills from the previous semester with knowledge about approaches to modeling turbulence and chemical reactions in the flow. Teach strategies for dealing with computational cases that do not allow obtaining numerical results without using multi-stage procedures characteristic of these flow classes, teach interpreting numerical results with particular emphasis on distinguishing physical effects, effects of the physical model and numerical effects.

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 ordered and theoretically founded general knowledge in the field of key technical issues and detailed knowledge 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

3. has knowledge of the method of presenting test results in the form of tables and graphs, performing the analysis of measurement uncertainties

4. has basic knowledge of research methods and how to prepare and conduct research, and knows the rules of editing a scientific work

5. has basic knowledge of metal, non-metal and composite materials used in machine construction, in particular about their structure, properties, methods of production, heat and thermo-chemical treatment and the influence of plastic processing on their strength, as well as fuels, lubricants, technical gases, refrigerants e.t.c.

6. has basic knowledge of environmental protection in transport, is aware of the risks associated with environmental protection and understands the specificity of the impact of mainly air transport on the environment as well as social, economic, legal and other non-technical conditions of engineering activities

7. has the ability to self-study with the use of modern teaching tools, such as remote lectures, websites and databases, teaching programs, e-books

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 use information and communication techniques, applicable at various stages of the implementation of aviation projects

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

4. can, when formulating and solving tasks related to civil aviation, apply appropriately selected methods, including analytical, simulation or experimental methods

5. is able to properly select materials for simple aviation structures, and can indicate the differences between the fuels used in aviation

6. is able to communicate using various techniques in the professional environment and other environments using the formal notation of construction, technical drawing, concepts and definitions of the scope of the study field of study

7. is able to design elements of means of transport with the use of data on environmental protection

8. student can use theoretical probability distributions. Student is able to analyze and interpret statistical data. Student is able to use the methods and tools of mathematical statistics in engineering practice

9. can use the language of mathematics (differential and integral calculus) to describe simple engineering problems.

10. Student is able to make a comprehensive assessment of the ecological parameters of an aircraft propulsion unit based on the values of emission factors for harmful gaseous compounds and particulate matter

11. is able to prepare a short research paper while maintaining the basic editorial rules. He can choose appropriate methods for the conducted research and is able to carry out a basic analysis of the results.

12. is able to organize, cooperate and work in a group, assuming various roles in it, and is able to properly define priorities for the implementation of a task set by himself or others

13. is able to plan and implement the process of 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 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

4. correctly identifies and resolves dilemmas related to the profession of an 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. Group complete project (analytical calculations, geometry design, CFD analysis) (65%)

2. Assessment of a small individual project (35%)

The project on the second semester of the subject (7th semester of study) should, as far as possible, be related to the subject of the student's engineering work and be a project with a much higher level of detail than the project carried out in the previous semester. It can be a development of the project from the previous semester.

To pass the course, it is required to obtain not less than 60% of component points.

The 60% -100% range assessment curve is determined individually in each semester.

Programme content

Lecture semester II:

Fundamentals of RANS methodology; turbulence modeling (hypotheses, models, limitations); Equation discretization schemes; introduction to structural mesh topology; differences between calculations on grids of different types; The range of available methodologies for turbulence modeling (DNS - LES - DES - RANS);

Laboratory semester II:

Making structured 2 and 3 dimensional meshes with complex topologies; Strategies for obtaining stationary solutions for transonic flows and flows with limited stability; using the results of numerical analyzes to create surrogate models of flow characteristics and their implementation for selected applications. Implementation of custom material models, including the UDRGM (user defined real gas model) in the Ansys Fluent environment.

PART - 66 (PRACTICE - 22.5 hours)

MODULE 16. PISTON ENGINE

16.7 Recharging / Turbocharging

Principles and purposes of supercharging and its influence on engine parameters;

Design and operation of the boost and turbo charging system; [2]

Teaching methods

1. Blackboard lecture

2. Laboratory in the computer room

3. Computational projects carried out using publicly available programming tools

Bibliography

Basic

Additional

Any adequate literature on topic

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	50	2,0
Making an individual project - performing numerical calculations and interpreting their results on a selected object (e.g. profile characteristics or determining the resistance coefficient for an object) Final project - developing an analytical model that allows you to design geometry, perform geometry and mesh in the selected software, perform analysis and describe the results, if necessary, redesign geometry and repeat the procedure [1]	25	1,0

[1] delete or add other activities as appropriate