COURSE DESCRIPTION CARD - SYLLABUS

Course name

Integrated aircraft engine design systems

Course

Field of study	Year/Semester
Aerospace Engineering	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)
30	30	
Tutorials	Projects/seminars	

Number of credit points

5

Lecturers

Responsible for the course/lecturer:	Responsible for the course/lecturer:
dr inż. Bartosz Ziegler	
bartosz.ziegler@put.poznan.pl	

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 detailed knowledge related to the methodologies currently used to support the engineering work of CAE systems in relation to the analysis and design of aviation components for propulsion systems.

2. Has ordered, theoretically founded general knowledge covering key issues in the field of thermodynamics, aerodynamics and gas dynamics, which allows determining the physicality of results obtained using CAE systems.

3. Has ordered, theoretically founded knowledge in the field of applied mathematics that allows selection of discretization schemes and numerical methods used for the analyzed problem.

Skills

1. Is able to obtain information from literature, the Internet, databases and other sources. In particular from English-language sources and software documentation.

2. is able to carry out elementary technical calculations in the field of fluid mechanics and thermodynamics, such as heat and mass balances, pressure losses in flows around technical flying objects and their modules, select parameters of fans, compressors and turbines for flow systems, and also calculate thermodynamic waveforms in heat machines.

3. is able to conduct computer simulations of flow phenomena associated with the work of components of aviation forces, interpret their results and draw conclusions.

Social competences

1. Is able to properly set priorities for the implementation of the task specified by himself or other based on available knowledge.

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 decisions.

3. Is able to inspire and organize the learning process of other people.

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	150	5,0
Classes requiring direct contact with the teacher	70	2,3
Making an individual project - performing numerical calculations	80	2,7

	Hours	ECTS
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]		

[1] delete or add other activities as appropriate