



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Aerodynamics [S1Lot2>Aero]

### Course

Field of study

Aviation

Year/Semester

1/2

Area of study (specialization)

–

Profile of study

general academic

Level of study

first-cycle

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

### Number of hours

Lecture

15

Laboratory classes

15

Other

0

Tutorials

15

Projects/seminars

0

### Number of credit points

2,00

### Coordinators

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### Lecturers

### Prerequisites

Student should have knowledge of mathematics and physics presented in the studies. He should be able to apply the scientific method in solving problems, carrying out experiments and reasoning, knows the limits of his own knowledge and skills, formulate questions precisely, understand the need for further education.

### Course objective

Teaching basic laws and relationships in the field of aerodynamics and dynamics of aircraft movement and the ability to physically interpret phenomena, as well as familiarizing oneself with basic equations describing aerodynamic parameters in the flow of solid bodies.

### Course-related learning outcomes

Knowledge:

1. has an extended and in-depth knowledge of mathematics and physics useful for formulating and solving complex technical tasks related to aviation and modeling real problems
2. has a structured and theoretically founded general knowledge in the field of key technical issues and detailed knowledge in the field of selected issues related to air transport flow

#### Skills:

1. can solve tasks using basic knowledge of aerodynamics, flight mechanics and body flow
2. can use the language of mathematics (differential and integral calculus) to describe simple engineering problems.

#### Social competence:

1. 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 serious loss of health and even life

#### Social competences:

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### Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Written exam from lecture

Written exam from exercises

Acceptance of laboratory exercises based on reports

### Programme content

Division of aerodynamic forces, definition of lift and drag, Bernoulli equation. Reynolds number, critical parameters and accumulation of gas, classification of gas flows, change of gas parameters in the flow through a conduit with variable cross-section, wave phenomena in the flow around key parts of external aircraft. normal and oblique shock wave, aviation profile families, aerodynamic characteristics, aerodynamic systems.

PART-66

#### MODULE 8. BASICS OF AERODYNAMICS

##### 8.1 Atmospheric physics

Application of the International Standard Atmosphere (ISA) for aerodynamics. [2]

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##### 8.2 Aerodynamics

Air flow around the body; Boundary layer, stratified flow, turbulent, undisturbed, relative air flow, stream deflection, vorticity, stagnation; Terms: aviation profile, chord, medium aerodynamic chord, profile resistance, resistance induced, pressure center, angle of attack, negative and positive buckling, volatility, wing shape and elongation; Thrust, weight, resultant aerodynamic; Generation of lift and resistance: angle of attack, lift, resistance, polar, stall; Pollution of the airfoil along with ice, snow, frost. [2]

#### MODULE 11B. AERODYNAMICS, STRUCTURES AND PISTON PLANE SYSTEMS

##### 11.1 Theory of flight

###### 11.1.1. Aircraft aerodynamics and flight control

Action and result: - tilt control: ailerons and air brakes; - height adjustment: headsets, integral tail, variable range ballasts and ducks; - yaw adjustment, rudder stops; Adjustment with the use of airplanes, butterfly tail; Lifting devices, gill slits, gills, flaps, flap hooks; Resistance devices, spoilers, air brakes, speed brakes; Aerodynamic comb lobe effects, fault leading edges; Boundary layer adjustment, vortex generators, stall wedges or leading devices boundary; Operation and effect of balancing flaps, relief and weighting (leading) flaps, flaps steering, spring flaps, mass balance, control surface inclination, aerodynamic adjustment panels. [2]

11.1.2. High-speed flights - not applicable - - [-]

### Course topics

The lecture program consists of the following parts: standard atmosphere, theory related to the lift force, basic information in the field of aerodynamics, basic aerodynamic characteristics, aircraft profiles, wings with finite aspect ratio and theory related to the drag force, basic information in the field of aircraft construction, mechanization wings, wings used in higher speed flows, theory of wave resistance, icing of aircraft, selected examples of numerical calculations in the field of Aerodynamics.

The exercise program consists of the following parts: construction of aircraft profiles based on the NACA family, basic calculations in the field of reference atmosphere and subsonic flows, basic calculations

regarding wings and flaps.

The laboratory program consists of the following parts: pressure distribution on an aircraft profile, determination of the drag force coefficient, aerodynamic characteristics of wings with various profiles, polar characteristics of wings, aerodynamic characteristics of wings with various aspect ratios, wing mechanization, aerodynamic characteristics of aircraft with various configurations.

### Teaching methods

1. Lecture: multimedia presentation
2. Tutorials: completing the tasks given by the teacher
3. Laboratories: performing measurements and calculations at the testing equipment

### Bibliography

Basic:

1. Sobieraj W., Aerodynamika, WAT, Warszawa 2014
2. Prosnak W.J., Równania klasycznej Mechaniki płynów, PWN, Warszawa 2006
3. Anderson J.D. Jr., Fundamentals of Aerodynamics, Fifth edition, McGraw-Hill, 2011

Complementary

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Additional:

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### Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	45	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	5	0,50