COURSE DESCRIPTION CARD - SYLLABUS

Course name
Fluid mechanics [S1Lot2-PSPL>MP]

Course

Field of study
Aviation

Year/Semester
2/4

Area of study (specialization)
Aircraft Piloting

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
15

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Program content of the subject "Fundamentals of fluid mechanics", semester 3

Course objective

To familiarize students with the basic theory and applications of mechanical fluids.

Course-related learning outcomes

Knowledge:
1. has structured and theoretically based general knowledge of key issues of technology and detailed knowledge of selected issues related to air transport, knows basic techniques, methods and tools used in the process of solving tasks related to air transport, mainly of an engineering nature
2. has knowledge of the method of presenting research results in tabular and graph form, performing measurement uncertainty analysis
3. the student knows basic probability distributions. The student knows basic concepts of mathematical statistics. The student knows various methods of statistical inference. Has structured, theoretically based knowledge in the field of mathematics used to analyze results, create

mathematical models and their adaptation to the numerical code

Skills:
1. is able to organize, cooperate and work in a group, assuming different roles in it and is able to appropriately determine priorities for the implementation of a task specified by himself or others
2. 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 understands that in technology knowledge and skills very quickly become outdated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 social role of a graduate of a technical university, in particular understands the need to formulate and convey to society, in an appropriate form, information and opinions concerning engineering activities, technical achievements, as well as the achievements and traditions of the engineering profession

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: exam
Exercises: tests
Laboratories: tests and report evaluation

Programme content

Expanding knowledge of the basics of fluid dynamics from the subject "Basics of fluid mechanics" to: Occurrence of tangential stresses in fluids, the concept of dynamic and kinematic viscosity, extension of Bernoulli's equation to include pressure losses, fluid compressibility, liquid compressibility and flows of ideal gases. Theory of one-dimensional isentropic gas flow. Fluid momentum, angular momentum flux. Dynamic reaction between flow and channel walls and special cases (jet engine and fluid-flow machines)
PART - 66 (THEORY - 22.5 hrs.)
MODULE 2. PHYSICS
2.2 Mechanics
2.2.4 Fluid dynamics
a) Specific gravity and density;
b) Viscosity, fluid resistance, effects of giving a streamlined shape;
Effects of fluid compression; [2]

Course topics

1. Shear Stresses in Fluids and Viscosity
Definition and occurrence of shear stresses in fluids
Dynamic viscosity: Newtonian vs. non-Newtonian fluids
Kinematic viscosity and its applications
Bernoulli’s Equation with Pressure Losses
2. Recap of Bernoulli’s equation
Energy losses due to friction and turbulence
Applications in engineering and fluid transport systems
Fluid and Liquid Compressibility
3. Definition and significance of compressibility
Bulk modulus and speed of sound in liquids
Real-world examples of liquid compressibility effects
Flows of Ideal Gases and Isentropic Flow Theory
4. Properties of ideal gases and flow assumptions
One-dimensional isentropic flow equations
Applications in nozzles, diffusers, and supersonic flows
Momentum and Angular Momentum in Fluid Mechanics
5. Momentum conservation in fluid flow
Angular momentum flux and applications
Examples in rotating machinery and vortex flows

Dynamic Interaction Between Flow and Channel Walls
6. Flow-induced forces on walls and structures
Boundary layers and wall shear stresses
Applications in pipelines, aircraft wings, and turbines
Special Cases: Jet Engines and Fluid-Flow Machines
7. Fluid dynamics in jet propulsion and turbomachinery
Thrust generation and efficiency
Practical applications in aerospace and industrial systems

Teaching methods

1. Lecture: multimedia presentation and on selection.
2. Calculation exercises: examples analyzed on the basis of and performed independently by the student.
3. Laboratories: presentation of the content and course of research, took place and was carried out.

Bibliography

Basic:
1. Ciałkowski M., Mechanika Płynów. Skrypty Uczelniane. Wydawnictwo Politechniki Poznańskiej.
2. Ciałkowski M., Bartoszewicz J., Frąckowiak A., Grudziński M., Grzelczak M., Kołodziej J., Piątkowski R., Rybarczyk J., Wróblewska A., Mechanika płynów: zbiór zadań z rozwiązaniami, Wydawnictwo Politechniki Poznańskiej, Poznań 2008.
3. Prosnak W.J. Mechanika Płynów, t. I. PWN Warszawa 1971

Additional:
1. Gołębiewski C., Łuczywek E., Walicki E., Zbiór zadań z mechaniki płynów, PWN Warszawa1978

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	35	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	15	0,50