SYLLABUS OF A MODULE

Polish name of a module	**Aerodynamika Środowiska**
English name of a module	**Environmental aerodynamics**
ISCED classification - Code	0715
ISCED classification - Field of study	Mechanics and metal trades
Languages of instruction	*English*
Level of qualification:	***2***
Number of ECTS credit points	*6*
Examination:	***A - assignment***
Available in semester:	*S*

Number of hours per semester:

Lecture	Exercises	Laboratory	Seminar	E-learning	Project
30	0	30	0	0	0

MODULE DESCRIPTION

MODULE OBJECTIVES

O1. Introduce basic knowledge and principles of aerodynamic

O2. Acquire abilities to perform physical and numerical modelling of the environmental flows

PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of physics, thermodynamics and basics of fluid mechanics
2. Ability of individual work and collaboration in a group

LEARNING OUTCOMES

LO 1 – Knowledge of the atmospheric boundary layer flow

LO 2 - Knowledge of aerodynamic forces and moments

LO 3 – Knowledge of flow phenomena modeling

LO 4 – Ability to carry out measurement and analysis of results obtained during implementation of laboratory exercises

MODULE CONTENT

Type of classes – lecture	**Number of hours**
Lec 1 - Basic tasks of environmental aerodynamics. History of aerodynamics.	**3**
Lec 2 - Basic aerodynamic principles and equations.	**3**
Lec 3 - Fundamentals of inviscid, compressible and incompressible flow.	**3**
Lec 4 - Flow over an airfoil.	**3**
Lec 5 - Aerodynamic forces and moments.	**3**
Lec 6 - Similarity theory and model analysis in aerodynamics.	**3**
Lec 7 - Aerodynamic flight.	**3**
Lec 8 - Knowledge of the atmospheric boundary layer flow.	**3**
Lec 9 – Introduction to flow around ground objects.	**3**
Lec 10 - Basic of wind engineering; Wind turbine aerodynamics	**3**
Type of classes– laboratory	**Number of hours**
Lab 1 - Basic research methods in a wind tunnel	**3**
Lab 2 - Measurement of aerodynamic characteristics of a cylinder	**3**
Lab 3 - Measurement of aerodynamic characteristics of an airfoil	**3**
Lab 4 - Experimental analysis of the angle of attack impact on the aerodynamic characteristics of an aviation profile	**3**
Lab 5 - Computer analysis of the angle of attack impact on the aerodynamic characteristics of an aviation profile	**3**
Lab 6 - Measurement of the aerodynamic drag coefficient Cx using an aerodynamic weight	**3**
Lab 7 - An example of the application of visualization methods in aerodynamics	**3**
Lab 8 - Identification of cylindrical vortex structures	**3**

Lab 9 - Computer analysis of the flow around ground objects	**3**
Lab 10 - Computer analysis of the aerodynamic coefficients of ground objects	**3**

TEACHING TOOLS

1. - Lecture with Power Point presentations, lecture notes
2. - Exercise stands equipped with measuring apparatus
3. - Computer laboratory, flow simulation software

WAYS OF ASSESSMENT (F – FORMATIVE, S – SUMMATIVE

F1. - assessment of preparation for laboratory exercises
F2. - assessment of the ability to apply the acquired knowledge while doing the exercises
F3. - evaluation of reports on the implementation of exercises covered by the curriculum
F4. - assessment of activity during classes
S1. - assessment of the ability to solve the problems posed and the manner of presentation obtained results - pass mark *
S2. - assessment of mastery of the teaching material being the subject of the lecture - exam

*) in order to receive a credit for the module, the student is obliged to attain a passing grade in all laboratory classes as well as in achievement tests.

STUDENT'S WORKLOAD

L.p.	**Forms of activity**	**Average number of hours required for realization of activity**
1. Contact hours with teacher		
1.1	Lectures	30
1.2	Tutorials	0
1.3	Laboratory	30
1.4	Seminar	0

1.5	Project	0
1.6	Examination	0
	Total number of contact hours with teacher:	65
2. Student's individual work		
2.1	Preparation for tutorials and tests	0
2.2	Preparation for laboratory exercises, writing reports on laboratories	50
2.3	Preparation of project	0
2.4	Preparation for final lecture assessment	20
2.5	Preparation for examination	0
2.6	Individual study of literature	15
	Total number of hours of student's individual work:	85
	Overall student's workload:	150
Overall number of ECTS credits for the module		6 ECTS
Number of ECTS points that student receives in classes requiring teacher's supervision:		2.4 ECTS
Number of **ECTS** credits acquired during practical classes including laboratory exercises and projects:		2.0 ECTS

BASIC AND SUPPLEMENTARY RESOURCE MATERIALS

Anderson Jr, J. D. (2010). *Fundamentals of Aerodynamics*. Tata McGraw-Hill Education.
Fernando H.J.S. (ed.): Handbook of Environmental Fluid Dynamics, 2012
Kundu P., Cohen I.: Fluid mechanics. Academic Press, 2010
Imberger J.: Environmental Fluid Dynamics: Flow Processes, Scaling, Equations of Motion, Academic Press Inc , 2006
Bertin, J. J., & Smith, M. L. (2001). *Aerodynamics for Engineers* (Vol. 6). Upper Saddle River, NJ: Prentice Hall.
Katz, J., & Plotkin, A. (2001). *Low-speed Aerodynamics* (Vol. 13). Cambridge University Press.
Anderson Jr, J. D. (2005). *Solutions Manual to Accompany Introduction to Flight*. Energy, 20(26), 6.
Anderson Jr, J. D. (1999). *A history of Aerodynamics: and Its Impact on Flying*

Machines (Vol. 8). Cambridge University Press.

MODULE COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

dr hab. inż. Renata Gnatowska, prof. PCz, renata.gnatowska@pcz.pl