Doctoral School
Warsaw University of Technology

COURSE OFFERED IN THE DOCTORAL SCHOOL

Code of the course	4606-ES-0000FHI-0080	Name of the course	Polish	**Zastosowanie metody CFD w przemyśle**
			English	**Application of CFD method in industry**
Type of the course	specialized			
Course coordinator	Professor Michał Makowski, Ph.D., D.Sc., Eng.	Course teacher	Piotr Tarnawski, Ph.D., Eng	
Implementing unit	Faculty of Automotive and Construction Machinery Engineering	Scientific discipline / disciplines*	Mechanical engineering; Civil Engineering, Geodesy and Transport; Environmental engineering, mining and power engineering	

Level of education	doctoral studies	Semester	winter		
Language of the course	English				
Type of assessment	Credit with a grade	Number of hours in a semester	26	ECTS credits	2
Minimum number of participants	10	Maximum number of participants	15	Available for students (BSc, MSc)	Yes

Type of classes		Lecture	Auditory classes	Project classes	Laboratory	Seminar
Number of hours	in a week	1		1		
	in a semester	13		13		

* does not apply to the Researcher's Workshop

1. Prerequisites

Fundamentals of thermodynamics, fluid mechanics, and heat transfer

2. Course objectives

The aim of the course is to acquire basic knowledge in the field of Computational Fluid Dynamics (CFD) and the ability to use ANSYS Fluent program, including building a computational grid, solver settings, defining boundary conditions, visualization of results, and methods of verification of results.

3. Course content (separate for each type of classes)

Lecture

- Theoretical basics of analitical fluid dynamics, heat transfer and thermodynamics.
- Description of the mathematical apparatus of differential equations.
- Derivation of the continuum equation
- Derivation of the momentum equation
- Derivation of the equation energy.

Laboratory

- Drag simulation of internal flow.
- Simulation of the aerodynamics of various objects.
- Simulation of forced and natural convection.
- Simulation of mixing gases with different chemical species.
- Simulation of filling the combustion chamber.
- Two-phase flow simulation - liquid and gas interaction.

4. Learning outcomes			
Type of learning outcomes	Learning outcomes description	Reference to the learning outcomes of the WUT DS	Learning outcomes verification methods*
Knowledge			
W01	Acquiring knowledge about physical phenomena occurring in fluids.	SD_W2	project evaluation
W02	Acquiring knowledge in the field of applying numerical fluid mechanics.	SD_W2	project evaluation
W03	Acquiring knowledge in the area of various computational methods of one problem and comparing the results.	SD_W2, SD_W3	project evaluation
Skills			
U01	Independent realization of two simulation projects	SD_U1, SD_U2, SD_U7	project evaluation
U02	Ability to use CFD simulation software	SD_S2	project evaluation
U03	The ability to present the results in the form of a technical report	SD_U4, SD_U6	project evaluation
Social competences			
K01	Critically reference the results of computer simulation studies obtained in the field of fluid flow.	SD_K1	assessment of activity during classes
K02	Consciously applying numerical methods to benefit society.	SD_K3	assessment of activity during classes

*Allowed learning outcomes verification methods: exam; oral exam; written test; oral test; project evaluation; report evaluation; presentation evaluation; active participation during classes; homework; tests

5. Assessment criteria
Assessment of the realization of two independent simulation projects. Building a geometric model and mesh, performing calculations, presenting the results, drawing conclusions from the simulation results.

6. Literature
Primary references: [1] ANSYS Fluent User's guide [2] J. Blazek, Computational Fluid Dynamics: Principles and Applications, ELSEVIER SCIENCE PUB CO 2006

7. PhD student's workload necessary to achieve the learning outcomes**		
No.	Description	Number of hours
1	Hours of scheduled instruction given by the academic teacher in the classroom	26
2	Hours of consultations with the academic teacher, exams, tests, etc.	2

3	Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework	13
4	Amount of time devoted to the preparation for exams, test, assessments	19
	Total number of hours	**60**
	ECTS credits	**2**

** 1 ECTS = 25-30 hours of the PhD students work (2 ECTS = 60 hours; 4 ECTS = 110 hours, etc.)

8. Additional information	
Number of ECTS credits for classes requiring direct participation of academic teachers	2
Number of ECTS credits earned by a student in a practical course	2