<table>
<tr><td>Course code</td><td></td></tr>
<tr><td>Type and description</td><td>EC – elective subjects from the discipline of Mechanical Engineering</td></tr>
<tr><td>ECTS credit</td><td>1</td></tr>
<tr><td>Course name</td><td>Advanced CFD project</td></tr>
<tr><td>Course name in Polish</td><td>Zaawansowany projekt CFD</td></tr>
<tr><td>Language of instruction</td><td>English</td></tr>
<tr><td>Course level</td><td>8 PRK</td></tr>
<tr><td>Course coordinator</td><td>dr hab. inż. Krzysztof Sobczak</td></tr>
<tr><td>Course instructors</td><td>dr hab. inż. Krzysztof Sobczak</td></tr>
<tr><td>Delivery methods and course duration</td><td>
<table>
<tr><th></th><th>Lecture</th><th>Tutorials</th><th>Laboratory</th><th>Project</th><th>Seminar</th><th>Other</th><th>Total of teaching hours during semester</th></tr>
<tr><td>Contact hours</td><td>0</td><td>0</td><td>0</td><td>5</td><td>0</td><td>0</td><td>5</td></tr>
<tr><td>E-learning</td><td>no</td><td>no</td><td>no</td><td>no</td><td>no</td><td>no</td><td>no</td></tr>
<tr><td>Assessment criteria (weightage)</td><td>0</td><td>0</td><td>0</td><td>100%</td><td>0</td><td>0</td><td>100%</td></tr>
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<tr><td>Course objective</td><td>1. The aim of the course is to enable PhD students to acquire comprehensive knowledge in the field of computational fluid dynamics.</td></tr>
<tr><td>Learning outcomes</td><td>After completing the course a PhD student can:

1. select equations of fluid dynamics for complex flow problems – outcome W1, U1, U4

2. characterize methods of turbulent flow simulations and select them for various flows – outcome W1, U4

3. characterize the finite volume method and determine the discretization uncertainty – outcomes W1, U1, U4

4. build numerical models, solve, validate and verify as well as interpret and analyze simulation results for complex fluid flow problems – outcomes W1, U1, U2, U3, K1</td></tr>
<tr><td>Assessment methods</td><td>Outcomes 1, 2, 3, 4 - project execution, participation in discussions during meetings with the instructor, final presentation of the project.

The final grade consists of: design execution - 50%; discussion - 25%; final presentation of the project - 25%.

The PhD student passes the course provided that he/she passes 60% threshold, while for each assessment method the PhD student has to achieve at least 50% of its score.</td></tr>
<tr><td>Prerequisites</td><td>Knowledge of fluid dynamics to characterize phenomena and conduct a basic analysis of the results of internal and external fluid flow problems.

Ability to use CAD software to prepare complex geometric models.

Ability to use CFD software available at the university to define, solve and present results of simple flow problems.</td></tr>
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Course content with delivery methods	PROJECT 1. Definition and analysis of complex fluid flow problems. Selection of fluid dynamics equations. 2. Preparation and simulations of complex fluid flow problems: preparation of geometry, mesh generation, task definition, simulations. 3. Verification and validation of simulation results. The mesh independence analysis. 4. Presentation and analysis of simulation results.
Basic reference materials	1. Charles Hirsch, ”Numerical Computations of Internal & External Flows”, Butterworth-Heinemann, 2007. 2. Sreenivas Jayanti, ”Computational Fluid Dynamics for Engineers and Scientists”, Springer, 2018. 3. Bengt Andersson, et. al., ”Computational Fluid Dynamics for Engineers”, Cambridge University Press, 2012. 4. Lecturer's materials.
Other reference materials	1. David C. Wilcox, ”Turbulence Modeling for CFD”, DWC Industries Inc., 2000. 2. ANSYS Help, Release 19.2, ANSYS, Inc., Canonsburg, PA, USA, 2018. 3. https://www.cfd-online.com/
Average student workload outside classroom	25 h
Comments	proposed semester: summer
Last update	July 2020