GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00065679						
Field of study	Mechanical Engineering						
Date of commencement of studies	February 2024		Academic year of realisation of subject	2024/2025			
Education level	second-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery	at the university			
Year of study	1		Language of instruction	Polish			
Semester of study	2		ECTS credits	5.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	Institute of Manufacturing and Materials Technology -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Bogdan Ścibiorski				
	Teachers		dr inż. Bogdan Ścibiorski				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	0.0	0.0	0.0	45
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours	Self-study		SUM
	Number of study hours	45		10.0	70.0		125
Subject objectives	To present key issues in the field of racing vehicle aerodynamics, with particular emphasis on the use of CFD methods in design, as well as the validation of achieved results through real-world conditions.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_K02] correctly identifies professional problems and is able to define the priorities and hierarchy using knowledge in solving problems	Correctly identifies the key professional challenges linked to vehicle aerodynamics and can determine the hierarchy of importance when optimizing racing vehicle construction. Applies acquired knowledge to effectively solve engineering problems, taking into account safety considerations and motorsport regulations.	[SK5] Assessment of ability to solve problems that arise in practice
[K7_U04] is able to prepare and present a presentation of a solution of a construction or technological task and results of performed experiments including the analysis of the results and possible changes in Polish or in a foreign language, is able to organize and manage the work of a team, directing the tasks	Is able to prepare and deliver presentations (in Polish or English) on CFD simulation results and aerodynamic testing, drawing conclusions and suggesting possible design changes. Can organize team efforts to conduct aerodynamic research and set task priorities related to airflow analysis and optimization.	[SU5] Assessment of ability to present the results of task
[K7_W03] possesses a profound knowledge on thermodynamic processes and their simulation, knows simulation methods and programs aiding the design and operation of power generating machines and process equipment, including renewable energy sources, air conditioning and cooling renewable energy sources, air conditioning and cooling	Has in-depth knowledge of phenomena related to airflow around racing vehicles and understands the thermodynamic processes involved in drag and downforce generation. Can identify appropriate simulation methods (also employed in energy devices or cooling systems) for optimizing aerodynamic solutions.	[SW3] Assessment of knowledge contained in written work and projects
[K7_W09] possesses profound knowledge on the directions of development of construction of machines, devices, calculating methods and systems aiding the design, materials and their properties, manufacturing methods and diagnostics, control-measurement equipment	Understands computational methods and systems that support aerodynamic design for vehicles, including Computational Fluid Dynamics (CFD), and recognizes their role in motorsports. Is aware of current trends in vehicle construction and measurement techniques, taking into account modern wind tunnel testing technologies and control-measurement apparatus.	[SW3] Assessment of knowledge contained in written work and projects

Subject contents

This course introduces the fundamentals of fluid dynamics in the context of automotive aerodynamics, emphasizing airflow, drag, and lift. Particular attention is paid to the use of Computational Fluid Dynamics (CFD) in the design process for racing vehicles. Various design solutions aimed at reducing aerodynamic drag and increasing downforce will also be discussed. The lecture is supplemented by an overview of methods used to validate aerodynamic solutions through wind tunnel testing and real-world racing tests.

Practical sessions involve the hands-on application of CFD software to analyze the aerodynamics of racing vehicles, enabling participants to perform independent simulations of airflow around a vehicle. Participants will then analyze the simulation results and compare them with data from aerodynamic tests of racing vehicles

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Discussion	60.0%	50.0%
Written documents (e.g., reports, presentations) documenting the results of analyses, simulations, and conclusions.	60.0%	50.0%

Recommended reading

Basic literature

Joseph Katz - Race Car Aerodynamics

Janusz Piechna - Podstawy aerodynamiki pojazdów

Xin Zhang, Jonathan Zerihan - Aerodynamics of a Double Element Wing in Ground Effect

	Supplementary literature	**Simon McBeath** *Competition Car Aerodynamics: A Practical Handbook* : Haynes Publishing, 2020 (4. wydanie)
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1. Fundamentals of fluid dynamics in the context of racing vehicles 2. Methods for reducing aerodynamic drag and increasing downforce 3. Introduction to Computational Fluid Dynamics (CFD) in the automotive industry 4. Modeling airflow around the body and aerodynamic components 5. Analysis of how aerodynamic components (splitter, diffuser, spoiler) affect vehicle performance 6. Relationship between aerodynamics and component cooling/temperature management 7. Body shape optimization in CFD simulations 8. Comparing real-world track tests with simulation results 9. Case studies of aerodynamics in various racing series	
Work placement	Not applicable	

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