GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00065677		
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	6.0
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	0.0	0.0	0.0	0.0	30
	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	30	20.0	100.0	150

Subject objectives	To present the key issues related to the design and analysis of load-bearing structures in racing vehicles, covering various types of frameworks (e.g., monocoque, space frame), the selection of lightweight materials (aluminum, titanium, carbon fiber), and methods for evaluating safety and stiffness under high loads.

Learning outcomes	<table><tr><th>Course outcome</th><th>Subject outcome</th><th>Method of verification</th></tr><tr><td>[K7_W10] possesses knowledge on the methods of technical and economic analysis of industrial systems and optimization of manufacturing systems; is familiar with the general principles of initiating and developing forms of individual entrepreneurship, particularly for innovative projects using the knowledge</td><td>Understands fundamental principles for optimizing production processes and can indicate the economic benefits derived from implementing new technologies in load-bearing structures. Knows how to conduct a techno-economic analysis of innovative solutions in the racing industry and can evaluate their market potential.</td><td>[SW2] Assessment of knowledge contained in presentation</td></tr><tr><td>[K7_U01] is able to acquire information from specialist literary sources and other sources regarding the construction and operation of machines and related disciplines in polish and in a foreign language, is able to conduct a self-learning process, is able to synthesize the information, form conclusions and justify opinions</td><td>Is able to effectively search for and critically assess information from scientific publications, industry standards, and patent databases related to load-bearing structures in racing vehicles. Draws conclusions based on collected data and translates them into practical design recommendations, providing sound engineering justification for chosen solutions</td><td>[SU2] Assessment of ability to analyse information</td></tr><tr><td>[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</td><td>Has knowledge of computational methods (e.g., FEA, CAE) used to predict how load-bearing structures behave under dynamic loads. Is aware of the latest material trends (e.g., carbon fiber, titanium alloys) and can explain how they influence the stiffness and safety of racing vehicles.</td><td>[SW3] Assessment of knowledge contained in written work and projects</td></tr><tr><td>[K7_U07] is able to perform a preliminary economic analysis of the undertaken engineering actions within the range of design, production and operation of machines and technical devices</td><td>Is able to perform a preliminary assessment of the cost-effectiveness of a racing vehicle's load-bearing structure, taking into account both material aspects and production costs. Analyzes various design options (e.g., monocoque vs. space frame) with respect to cost-effectiveness, while considering operational conditions.</td><td>[SU5] Assessment of ability to present the results of task</td></tr></table>
Subject contents	The course includes an introduction to various types of load-bearing structures in racing vehicles, such as monocoque and space frame designs, along with a discussion of their functions. Particular emphasis will be placed on material selection, focusing on lightweight materials such as aluminum, titanium, and carbon fiber, which significantly affect the stiffness and safety of racing vehicles. Methods for analyzing stresses and deformations in racing vehicles will be presented, especially in the context of loads encountered during cornering, acceleration, and braking. Additionally, design considerations, such as torsional stiffness and the impact of aerodynamics on vehicle structure, will be discussed. The course will conclude with a review of case studies on high-performance vehicles, including structures used in Formula 1.
Prerequisites and co-requisites	
Assessment methods and criteria	<table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>discussion</td><td>60.0%</td><td>50.0%</td></tr><tr><td>Written documents (e.g., reports, presentations) documenting the results of analyses, simulations, and conclusions</td><td>60.0%</td><td>50.0%</td></tr></table>
Recommended reading	<table><tr><td>Basic literature</td><td>1. Danielsson, O., & Cocana, A. G. Influence of Body Stiffness on Vehicle Dynamics Characteristics in Passenger Cars. 2015. 2. Milliken, W. F., & Milliken, D. L. . Race Car Vehicle Dynamics. Society of Automotive Engineers (1995). 3. Deakin, A., Crolla, D., Ramirez, J. P., & Hanley, R. (Rok wydania nieznany). The Effect of Chassis Stiffness on Race Car Handling Balance. Society of Automotive Engineers (2000). 4. Balkwill, J. Performance Vehicle Dynamics. Independently Published (2017). 5. Costin, M., & Phipps, D. . Racing and Sports Car Chassis Design. B. T. Batsford Ltd.</td></tr></table>

	Supplementary literature	**Smith, C.**: *Tune to Win: The Art and Science of Race Car Development and Tuning*. Aero Publishers. (2004). **Bosch Automotive Handbook** *Automotive Handbook* (10th Edition). Wiley. (2021).
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1. Types of load-bearing structures in racing vehicles (monocoque, space frame) 2. Use of lightweight materials (aluminum, titanium, carbon fiber) in racing frameworks 3. Stress and strain analysis under high loads (braking, acceleration, cornering) 4. Simulation methods (CAE, FEA) for designing load-bearing structures 5. Regulations and standards for load-bearing structures in motorsport (e.g., FIA) 6. Manufacturing technologies for structural components (e.g., welding, laminating, CNC machining) 7. Designing load-bearing structures with regard to aerodynamics and cooling 8. Case studies of load-bearing structures in selected racing series	
Work placement	Not applicable	

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