



Subject card

Subject name and code	Electrical and Alternative Drive Systems in Vehicles, PG_00055521						
Field of study	Mechanical Engineering						
Date of commencement of studies	October 2021	Academic year of realisation of subject			2023/2024		
Education level	first-cycle studies	Subject group			Optional subject group Subject group related to scientific research in the field of study		
Mode of study	Full-time studies	Mode of delivery			at the university		
Year of study	3	Language of instruction			Polish		
Semester of study	6	ECTS credits			5.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Jacek Kropiwnicki				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	15.0	0.0	60
	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	60		5.0		60.0	125
Subject objectives	Presentation of the modern achievements and tendencies in the area of electric and alternative vehicle propulsion systems, classification, as well as an indication of the possible application nowadays and in the future, with particular emphasis on Polish conditions.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_U05] is able to plant an experiment within the range of measuring the basic operating parameters of mechanical devices using a specialized equipment, interpret the results and reach the correct conclusions	Can use modern tools and knowledge in designing, operating and components selecting of vehicle drive systems.			[SU1] Assessment of task fulfilment		
	[K6_W08] possesses basic knowledge including the methodology of designing machine parts, mechanical devices, selection of construction materials, manufacturing and operation, with the lifetime cycle	Can analyse and evaluate the methods of functioning of the electric and alternative drive systems.			[SW1] Assessment of factual knowledge		
	[K6_U07] is able to design a typical construction of a mechanical device, component or a testing station using appropriate methods and tools, adhering to the set usage criteria	Student designs alternative drive system, projects components, makes thermal and efficiency calculations.			[SU1] Assessment of task fulfilment		
	[K6_W11] possesses knowledge on design, technology and manufacturing of machine parts, metrology, and quality control; knows and understands methods of measuring and calculating basic values describing the operation of mechanical systems, knows basic calculating methods applied to analyse the results of experiments	Understands the specificity of drive systems, understands the consequences of the selected solutions in terms of achieved energetics parameters of the system.			[SW1] Assessment of factual knowledge		

Subject contents	<p>Lecture: General information on the configuration of the propulsion systems, characteristics of the electric, hydrogen-powered, hybrid and alternative propulsion systems, vehicle energy demand for propulsion, cold and heat generation, own consumption, regenerative braking, environmental impact, test and real operation conditions, vehicle range calculations, alternative fuels, charging stations, battery replacement and refuelling, diagnostics and autonomous driving systems.</p> <p>Project: Calculation of the vehicle's energy demand for propulsion, cooling and heat generation, own consumption, vehicle range calculations, range extender system calculations, route optimization, optimization of the hybrid drive system control strategy.</p> <p>Laboratory: identification of real urban driving conditions, energy consumption in real operating conditions, determination of the total efficiency of the electric drive system, determination of the total efficiency of the hybrid drive system, identification of the operating modes of the hybrid system, fuel cell characteristics.</p>														
Prerequisites and co-requisites															
Assessment methods and criteria	<table border="1"> <thead> <tr> <th data-bbox="459 573 794 607">Subject passing criteria</th> <th data-bbox="802 573 1137 607">Passing threshold</th> <th data-bbox="1145 573 1481 607">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="459 618 794 651">Project</td> <td data-bbox="802 618 1137 651">50.0%</td> <td data-bbox="1145 618 1481 651">30.0%</td> </tr> <tr> <td data-bbox="459 663 794 696">Laboratory reports</td> <td data-bbox="802 663 1137 696">90.0%</td> <td data-bbox="1145 663 1481 696">10.0%</td> </tr> <tr> <td data-bbox="459 707 794 741">Test (lecture)</td> <td data-bbox="802 707 1137 741">50.0%</td> <td data-bbox="1145 707 1481 741">60.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Project	50.0%	30.0%	Laboratory reports	90.0%	10.0%	Test (lecture)	50.0%	60.0%
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Recommended reading	Basic literature	<p>Merkisz J.: UKŁADY MECHANICZNE POJAZDÓW HYBRYDOWYCH. Wydawnictwo Politechniki Poznańskiej.</p> <p>Kropiwnicki J. Modelowanie układów napędowych pojazdów z silnikami spalinowymi. AGNI.</p> <p>Ghosh T.K., Prelas M.A.: Energy Resources and Systems. Springer Dordrecht Heidelberg London New York.</p>													
	Supplementary literature	<p>http://www.combustion-engines.eu</p> <p>http://www.ijat.net</p>													
	eResources addresses														
Example issues/ example questions/ tasks being completed	<p>Characterize the basic types of hybrid systems, give their advantages and disadvantages.</p> <p>Present the calculation diagram of the total vehicle energy consumption of the type "well to wheel", compare the energy efficiency of the classic and electric drive system.</p> <p>Calculate how much the range of an electric vehicle will change if its average speed increases by 30%.</p>														
Work placement	Not applicable														