



Subject card

Subject name and code	Electromobility I , PG_00058349						
Field of study	Hydrogen Technologies and Electromobility						
Date of commencement of studies	October 2022	Academic year of realisation of subject			2023/2024		
Education level	first-cycle studies	Subject group			Obligatory subject group in the field of study 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	2	Language of instruction			Polish		
Semester of study	4	ECTS credits			4.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Department of Electrical Engineering of Transport -> Faculty of Electrical and Control Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Leszek Jarzębowicz					
	Teachers	dr inż. Aleksander Jakubowski					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	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	6.0		49.0		100
Subject objectives	The student learns the characteristics of independently-powered and hybrid electric vehicles found in road and rail transportation, as well as marine, aviation, and military and space applications. Acquires skills in programming an autonomous electric vehicle and its driving functions. The student is able to select the type and capacity of energy storage for a given vehicle and its driving cycle. Evaluates the environmental impact of a vehicle with a given propulsion system. Estimates the cost of implementation and operation of electromobility solutions.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_W10] knows the basics of the processing, use and rational use of electricity, including the principles of electric traction in various transport systems	The student is able to justify the selection of an energy storage unit for a vehicle, taking into account economic and environmental aspects, as well as the applicability of the solution.			[SW2] Assessment of knowledge contained in presentation		
	[K6_W16] He has basic knowledge of the current state and the latest development trends related to the field of study.	The student is able to select the type and capacity of energy storage that allows the vehicle to meet the range and driving profile requirements.			[SW3] Assessment of knowledge contained in written work and projects		
	[K6_W15] he has knowledge of the construction, principles of operation and operation of electromagnetic energy converters used in transport systems and systems.	The student knows the structures of drive and power systems of electric vehicles.			[SW1] Assessment of factual knowledge		
	[K6_U12] can formulate a specification of simple engineering tasks of a practical nature related to the field of study	The student knows the techniques of energy-efficient driving (eco-driving) and can use them to reduce the energy intensity of the vehicle.			[SU3] Assessment of ability to use knowledge gained from the subject		

Subject contents	<p>LECTURE: Energy intensity of catenary hybrid electric vehicles; Vehicular and stationary energy storage. BMS and EMS systems. Vehicle fuel cell converters and controls. Powertrain structures of electric and hybrid vehicles. Methods of assessment of the energy intensity of electric and hybrid vehicles. Micromobility. Economic and environmental consequences of electromobility development. Electromobility in marine, aerospace and military technology. Unusual applications of electromobility - levitating vehicles, mobile robots, exoskeletons and nanorobots.</p> <p>LABORATORY: Communication and control of a mobile robot. Autonomous vehicle operation. Active cruise control. Selection of parameters of a rail hybrid vehicle. Control of an unmanned aerial vehicle. Basics of eco-driving.</p>											
Prerequisites and co-requisites	Basic knowledge of electrical engineering, electronics and computer science.											
Assessment methods and criteria	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:33%;">Subject passing criteria</th> <th style="width:33%;">Passing threshold</th> <th style="width:33%;">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Preparation for the exercise, Report submission</td> <td>60.0%</td> <td>40.0%</td> </tr> <tr> <td>Exam</td> <td>60.0%</td> <td>60.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Preparation for the exercise, Report submission	60.0%	40.0%	Exam	60.0%	60.0%
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Exam	60.0%	60.0%										
Recommended reading	<p>Basic literature</p> <p>Rufer A., Energy Storage Systems and Components. Taylor & Francis Group, 2018.</p> <p>Abad G., Power Electronics and Electric Drives for Traction Applications. Wiley, 2017.</p> <p>Karwowski K. (red.), Energetyka transportu zelektryfikowanego. Poradnik inżyniera. Wyd. Politechniki Gdańskiej. Gdańsk, 2018.</p> <p>Hayes J.G., Goodarzi G.A.: Electric Powertrain. Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles. Wiley 2018.</p>											
	<p>Supplementary literature</p> <p>Sørensen B., Renewable Energy conversion, transmission and storage. Academic Press 2007.</p> <p>Dicks A. L., Rand D. A. J., Fuel Cell Systems Explained. Wiley 2018.</p> <p>IEEE Vehicular Technology Magazine</p> <p>Equipment datasheets and manufacturer catalogues</p>											
	<p>eResources addresses Adresy na platformie eNauczanie:</p>											
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> 1. Compare energy storage devices used in electric vehicles. 2. Discuss the definition of a hybrid vehicle, give examples using power train block diagrams. 3. Outline the advantages and disadvantages of using fuel cells to power vehicles 4. Discuss the impact of electromobility on the carbon footprint of transportation. What is the CO2 equivalent emissions? 											
Work placement	Not applicable											