GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mechatronics of Vehicles, PG_00038124		
Field of study	Automation, Robotics and Control Systems		
Date of commencement of studies	October 2020	Academic year of realisation of subject	2022/2023
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	5	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
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. Dariusz Karkosiński	
	Teachers	dr hab. inż. Dariusz Karkosiński dr inż. Łukasz Sienkiewicz	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	15.0	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	8.0	37.0	75

Subject objectives

Understanding the components of automotive mechatronic equipment, basic construction and diagnostics of the ignition and injection systems, the principles of operation of the automatic bearbox and the vehicle traction control.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_U02	The student is able to interact and work in a group taking different roles in it and setting priorities for the implementation of a specific task. The student carries out laboratory tasks in the group regarding the compilation, commissioning and testing of mechatronics systems and devices of motor vehicles	[SU2] Assessment of ability to analyse information
K6_K02	The student conducts a series of tests of the above-mentioned devices and assess their correct operation. Collectively, it undertakes and carries out the process of designing and simulating car sensor and actuator systems.	[SK1] Assessment of group work skills [SK5] Assessment of ability to solve problems that arise in practice [SK2] Assessment of progress of work
K6_W10	The student undertakes and carries out the process of designing and simulating car sensor systems and actuators, and selects programming tools for their diagnostics in the vehicle.	[SW3] Assessment of knowledge contained in written work and projects

Subject contents

LECTURE Elektro-mechatronic equipments of vehicle: working conditions and the associated requirements. Devices to energy storing. Classification and construction of electrical machines in the internal combustion engine and hybrid powered cars: alternators, starters, integrated starters-alternators, electric auxiliary drives. Selection rules for selection of alternators. Construction and diagnostics plugs and fuel injection systems: sensors, actuators, controllers and fuel supply systems of the spark ignition and diesel engines. Ecological aspects of automotive development. Solution and equipment leading to a reduction of toxic emissions. On-board diagnostic systems. Communication networks. Vehicle traction control systems.
PROJECTS Determination of electrical and magnetic properties of alternators. Selection of the alternator with built-in rectifier and voltage regulator to the vehicle"s electrical installation. Modeling the alternator in selected states of the installation of a vehicle using Saber. Design and execution of connections of the wiper drive with the switch on the steering wheel.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="3">Basic knowledge of electrical engineering and electronics.</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Project</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>Midterm colloquium</td><td>50.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">1. J.Ocioszyński, Zespoły elektryczne i elektroniczne w samochodach. WNT 1999.
2. Z.Kneba, S.Makowski, Zasilanie i sterowanie silników. WKiŁ 2004.
3. U.Rokosch, Układy oczyszczania spalin i pokładowe systemy diagnostyczne samochodów OBD. WKiŁ 2007.
4. D.Karkosiński, Badanie alternatora, Instrukcja ćwiczenia laboratoryjnego, Politechnika Gdańska, Gdańsk 2001.</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">1. J.Merkisz, S.Mazurek, pokładowe systemy diagnostyczne pojazdów samochodowych OBD. WKiŁ 2007.
2. Praca zbiorowa. Mikroelektronika w pojazdach samochodowych, z cyklu Informatory techniczne Bosch, WKiŁ 2007.
3. Praca zbiorowa. Sterowanie silników o zapłonie iskrowym. Układy Motronic z cyklu Informatory techniczne Bosch, WKiŁ 2007.
4. Praca zbiorowa. Sterowanie silników o zapłonie samoczynnym, z cyklu Informatory techniczne Bosch, WKiŁ 2007.
5. Saber, 1.4KW, 3-Phase, 12-Pole 14.45V DC Dynamic Thermal Alternator with Charging System Loads and Battery, Appendix: Alternator Laboratory Measurement Tests and Methods, Mast Template Library 2006.</td></tr>
<tr><td>eResources addresses</td><td colspan="2"></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">Discuss the environmental conditions reducing life electrical and electronic equipment in the car. Present the dependence on the capacity of the battery temperature. Provide dependence on the battery capacity charging current. Provide a diagram of the new generation of compact alternator. Provide a current-velocity characteristics of the alternator 14V, 50-90A. Discuss and sketch the construction of the alternator claw rotor. Draw the current waveform of the excitation alternator voltage regulator for two different angular velocities. Present patterns of starter solenoid switch for the two types of excitation. Describe the electric machine features an integrated hybrid IMA? Provide mechanical characteristics of the drive. What ways to change the angular velocity are used to drive fans and blowers? What ways to change the angular velocity are used to drive the wiper? What part of the wiper drive is responsible for accurate them stop at the bottom of the wind glass? How do it apply the brake for wiper drives? Provide dependence engine cylinder pressure as a function of angle for optimum ignition, and too early and too late. Provide design classic ignition system. Illustrate the phases of the spark plug ignition. Describe the voltage at the electrodes in the spark plug ignition. Draw a diagram of the ignition system with static high-voltage distribution. Determine the construction of four sensors cooperating with microprocessor ignition system. Present the types of injection. Discuss and illustrate the adaptive fuel delivery control loop negative feedback regulation. Describe the construction and operation of narrow-band oxygen sensor. Discuss the third-generation power engines with compression ignition (CI). Present the 3 variants of ABS systems for the brake system type II, and two variants for the type X. Discuss the effects of the ABS system. Present sensors and discuss the effects of the anti-slip ASR system. Replace sensors and discuss the operation of the ESP system. What is an OBD (On Board Diagnostic)? Present the components and systems of the highest risk issue monitored by the OBD system. Present the 3 types of diagnostic tests performed by the OBD system. Give the classification of OBD diagnostic monitors. Discuss ways to monitor the implementation of the combustion process (identification misfire). Present the communication networks used in motor vehicles.</td></tr>
<tr><td>Work placement</td><td colspan="3">Not applicable</td></tr>
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