



Subject card

Subject name and code	Mechatronics of Vehicles, PG_00063600						
Field of study	Electrical Engineering						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2026/2027		
Education level	second-cycle studies		Subject group		Specialty subject group Subject group related to scientific research in the field of study		
Mode of study	Part-time studies		Mode of delivery		at the university		
Year of study	2		Language of instruction		Polish		
Semester of study	3		ECTS credits		2.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Electrified Transportation -> Faculty of Electrical and Control Engineering -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Dariusz Karkosiński				
	Teachers		dr hab. inż. Dariusz Karkosiński dr inż. Andrzej Augusiak				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	10.0	0.0	10.0	0.0	0.0	20
	E-learning hours included: 0.0						
	eNauczanie source addresses: Moodle ID: 7258 MECHATRONIKA POJAZDÓW [Niestacjonarne][ET][2026/27] https://enauzanie.pg.edu.pl/2025/course/view.php?id=7258						
	Additional information:						
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	20		5.0		25.0	50
Subject objectives	Overview of automotive electromechanical equipment: operating conditions and associated requirements. Electrical energy storage devices. Classification and construction of electrical machines in internal combustion and hybrid vehicles: alternators, starters, integrated starter-generators, and auxiliary electric drives. Principles of alternator selection. Construction and diagnostics of ignition and fuel injection systems: sensors, actuators, and control units for spark-ignition and compression-ignition engines. Environmental aspects of automotive development. Solutions and equipment for reducing toxic emissions. On-board diagnostic systems. Communication networks. Vehicle traction control systems. Determination of electrical characteristics for alternators, ignition systems, sensors, and actuators.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_W07] has an in-depth, theoretically grounded knowledge of electromechanical systems and their electromechanical systems and their design, electrotraction systems power supply and electrical energy storage devices		The student recognizes automotive sensor and actuator systems.		[SW3] Assessment of knowledge contained in written work and projects		
	[K7_U05] is able to select equipment and carry out electrical measurements, design measuring systems for the determination of nonelectrical quantities, and analyse the results obtained		The student connects measurement circuits to determine the characteristics of sensors, transducers, and actuators. The student conducts series of tests on the aforementioned devices and evaluates their correct operation.		[SU3] Assessment of ability to use knowledge gained from the subject		
	[K7_K03] can interact and work in a group assuming various roles and identify priorities for the achievement of a specific task		The student works independently, collaborates within a professional group, and organizes a schedule for completing the assigned task.		[SK5] Assessment of ability to solve problems that arise in practice		

Subject contents	Course content – lecture		
	723 Electromechanical automotive equipment: operating conditions and associated requirements. Electrical energy storage devices. Classification and construction of electrical machines in internal combustion and hybrid vehicles: alternators, starters, integrated starter-generators, and auxiliary electric drives. Principles of alternator selection. Construction and diagnostics of ignition and fuel injection systems: sensors, actuators, and control units for spark-ignition and compression-ignition engines. Environmental aspects of automotive development. Solutions and equipment for reducing toxic emissions. On-board diagnostic systems. Communication networks. Vehicle traction control systems.		
	Course content – laboratory		
	329 Ex. 1 – Alternator, Ex. 2 – Starter motor, Ex. 3 – Windshield wipers (no report required), Ex. 4 – Sensors in internal combustion engine vehicles, Ex. 5 – Actuators in internal combustion engine vehicles, Ex. 6 – Ignition systems, glow plugs, Ex. 7 – Electric vehicle driving (in groups of 2–3), Ex. 8 – Battery diagnostics		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
		50.0%	50.0%
		50.0%	50.0%
Recommended reading	Basic literature	J.Ocioszyński, Zespoły elektryczne i elektroniczne w samochodach. WNT 1999. Z.Kneba, S.Makowski, Zasilanie i sterowanie silników. WKiŁ 2004. U.Rokosch, Układy oczyszczania spalin i pokładowe systemy diagnostyczne samochodów OBD. WKiŁ 2007. D.Karkosiński, Badanie alternatora, Instrukcja ćwiczenia laboratoryjnego, Politechnika Gdańska, Gdańsk 2001.	
	Supplementary literature	J.Merkisz, S.Mazurek, pokładowe systemy diagnostyczne pojazdów samochodowych OBD. WKiŁ 2007. Mikroelektronika w pojazdach samochodowych, z cyklu Informatory techniczne Bosch, Praca zbiorowa. WKiŁ 2007. Sterowanie silników o zapłonie iskrowym. Układy Motronic z cyklu Informatory techniczne Bosch, Praca zbiorowa. WKiŁ 2007. Sterowanie silników o zapłonie samoczynnym, z cyklu Informatory techniczne Bosch, Praca zbiorowa.	
	eResources addresses		

Example issues/ example questions/ tasks being completed	Discuss the environmental conditions that reduce the durability of automotive electrical and electronic devices. Present the relationship between battery capacity and temperature. Present the relationship between battery capacity and the magnitude of the current drawn. Present the connection diagram for a new-generation compact alternator. Present the current-speed characteristic of an alternator rated at 14V, 50–90A. Discuss and sketch the construction of an alternator's claw-pole rotor. Draw the waveform of the alternator's excitation current (controlled by a voltage regulator) for two different angular speeds. Present schematics of starters with electromagnetic solenoids for two types of excitation. List the types of engagement mechanisms used in DC starters. What is the purpose of an overrunning clutch? Explain—and describe using a formula—the pulsating speed profile of the starter during the cranking of an internal combustion engine. List the functions of the electric machine in the IMA integrated hybrid drive system. Present the mechanical characteristics of the drive. What methods of angular speed control are used in fan and blower drives? What methods of angular speed control are used in wiper drives? Which component of the wiper drive mechanism ensures precise stopping at the bottom edge of the windshield? What braking method is used in wiper drives? Present the relationship between cylinder pressure and crankshaft angle for a spark-ignition (SI) engine under optimal, advanced, and retarded ignition timing conditions. Present a schematic of a conventional ignition system. List and illustrate the operating phases of the ignition system. Sketch the voltage waveform at the spark plug electrodes during ignition. Draw a schematic of an ignition system with static high-voltage distribution. List and describe the construction of four sensors that work with a microprocessor-based ignition system. List the types of fuel injection systems for spark-ignition (SI) engines. Discuss and illustrate adaptive fuel metering control using a negative feedback loop. Discuss the construction and operation of a narrowband lambda sensor. Discuss the operation of an electric idle speed actuator. List the functions performed by an integrated microprocessor-based control system for SI engines. Discuss the 3rd-generation common-rail fuel supply system for compression-ignition (CI) engines. List three variants of ABS configurations for Type II brake systems and two variants for Type X systems. List the sensors and discuss the operation of the ABS anti-lock braking system. List the sensors and discuss the operation of the ASR traction control system. List the sensors and discuss the operation of the ESP electronic stability program. What is the OBD (On-Board Diagnostics) system? List the components and systems posing the highest emissions risk that are monitored by the OBD system. List the components and systems posing a medium emissions risk that are monitored by the OBD system. List three types of diagnostic tests performed by the OBD system. Provide a classification of OBD diagnostic monitors. Discuss the implementation methods for the combustion process monitor (misfire detection). Discuss the decision-making strategies used in on-board diagnostic systems since 2000. List the communication networks employed in motor vehicles.
Practical activities within the subject	Field exercises

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