GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mechatronics of Vehicles, PG_00063600		
Field of study	MECHATRONIKA POJAZDÓW		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
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 -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Dariusz Karkosiński	
	Teachers	dr hab. inż. Dariusz Karkosiński dr hab. inż. Mikołaj Bartłomiejczyk	

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

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

Electromechatronic equipment in automotive vehicles: operating conditions and related requirements. Electrical energy storage devices: batteries. Classification and construction of electric machines in combustion and hybrid vehicles: alternators, starters, integrated starter-alternators, electric auxiliary drives. Principles of alternator selection. Construction and diagnostics of ignition and injection systems: sensors, actuators, controllers for spark-ignition and compression-ignition engines. Environmental aspects of automotive development. Solutions and equipment leading to reduced toxic emissions. On-board diagnostic systems. Automatic transmissions. Vehicle traction control systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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 and cooperates in a professional group and organizes a time schedule for solving the assigned task.	[SK1] Ocena umiejętności pracy w grupie
[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 systems to determine the characteristics of sensors, transducers, and actuators. The student conducts a series of tests of these devices and assesses their correct operation.	[SU4] Ocena umiejętności korzystania z metod i narzędzi
[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 the sensor and actuator systems of a car.	[SW2] Ocena wiedzy zawartej w prezentacji

Subject contents	Electromechatronic equipment in automotive vehicles: operating conditions and related requirements. Electrical energy storage devices: batteries. Classification and construction of electric machines in combustion and hybrid vehicles: alternators, starters, integrated starter-alternators, electric auxiliary drives. Principles of alternator selection. Construction and diagnostics of ignition and injection systems: sensors, actuators, controllers for spark-ignition and compression-ignition engines. Environmental aspects of automotive development. Solutions and equipment leading to reduced toxic emissions. On-board diagnostic systems. Automatic transmissions. Vehicle traction control systems. Exercise 1. - Alternator, Exercise 2. - Starter, Exercise 3. - Wipers (without report) Exercise 4. - Sensors of combustion cars, Exercise 5. - Actuators of combustion cars, Exercise 6. - Ignition systems, glow plugs, Exercise 7. - Electric car - driving in groups of 2-3 people Exercise 8. - Battery diagnostics
Prerequisites and co-requisites	Theoretical Electrical Engineering Operating Principles of Internal Combustion Engines

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
lab reports	50.0%	50.0%
written test	50.0%	50.0%

Recommended reading

Basic literature	• Z.Kneba, S.Makowski, Zasilanie i sterowanie silników. WKiŁ 2004. • U.Rokosch, Układy oczyszczania spalin i pokładowe systemy diagnostyczne samochodów OBD. WKiŁ 2007.
Supplementary literature	• J.Merkisz, S.Mazurek, pokładowe systemy diagnostyczne pojazdów samochodowych OBD. WKiŁ 2007. • Praca zbiorowa. Mikroelektronika w pojazdach samochodowych, z cyklu Informatory techniczne Bosch, WKiŁ 2007. • Praca zbiorowa. Sterowanie silników o zapłonie iskrowym. Układy Motronic z cyklu Informatory techniczne Bosch, WKiŁ 2007. • Praca zbiorowa. Sterowanie silników o zapłonie samoczynnym, z cyklu Informatory techniczne Bosch, WKiŁ 2007. • Bosch Automotive Electrics and Automotive Electronics. Systems and Components, Networking and Hybrid Drive. 5th Edition Springer Vieweg • Tom Denton, Automobile Electrical and Elektronic System. Third Eition ELESEVIER
eResources addresses	

Example issues/ example questions/ tasks being completed	Discuss environmental conditions that reduce the durability of electrical and electronic devices in a vehicle. Demonstrate the relationship between battery capacity and temperature. Demonstrate the relationship between battery capacity and current draw. Present a wiring diagram for a new-generation compact alternator. Demonstrate the current-speed characteristic of a 14V, 50-90A alternator. Discuss and sketch the structure of an alternator's claw rotor. Draw the excitation current waveform of an alternator with a voltage regulator for two different angular speeds. Demonstrate diagrams of starters with an electromagnetic switch for two types of excitation. List the types of clutch mechanisms in DC starters. What is the purpose of a one-way clutch? Explain and use a formula to describe the pulsating speed waveform of a starter motor during combustion engine starting. List the functions of the electric machine in an integrated hybrid drive (IMA). Present the mechanical characteristics of the drive. What methods of changing angular speed are used in fan and blower drives? What methods of changing angular speed are used in windshield wiper drives? Which wiper drive element is responsible for precisely stopping the wipers at the lower edge of the windshield? What braking method is used in wiper drives? Describe the relationship between cylinder pressure in a spark-ignition engine and rotation angle for optimal, premature, and delayed ignition. Describe a diagram of a classic ignition system. List and illustrate the operating phases of an ignition system. Sketch the voltage waveform across the spark plug electrodes during ignition. Draw a diagram of an ignition system with static high-voltage distribution. List and define the structure of four sensors working with a microprocessor-based ignition system. List the types of injection systems in spark-ignition engines. Discuss and illustrate adaptive fuel control with a negative feedback loop for fuel control. Discuss the structure and operation of a narrowband lambda sensor. Discuss the operation of the electric idle speed actuator. List the functions performed by an integrated microprocessor-based spark-ignition engine control system. Discuss the accumulator fuel supply of third-generation compression-ignition (CI) engines. List three variants of ABS systems for Type II braking systems and two variants for Type X. List the sensors and discuss the operation of the ABS anti-lock braking system. List the sensors and discuss the operation of the ASR anti-skid system. List the sensors and discuss the operation of the ESP electronic stability program. What is the OBD (On-Board Diagnostic) system? List the components and systems with the highest emission risk monitored by the OBD system. List the components and systems with a medium emission risk monitored by the OBD system. List three types of diagnostic tests performed by the OBD system. Classify OBD diagnostic monitors. Discuss methods for implementing a combustion process monitor (misfire identification). Discuss the decision-making strategies in on-board diagnostic systems in force since 2000. List the communication networks used in automotive vehicles.
Practical activites within the subject	Field exercises

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