GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Electric water vehicles, PG_00059857		
Field of study	Automation, Robotics and Control Systems		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2023/2024
Education level	first-cycle studies	Subject group	
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	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Controlled Electric Drives -> Faculty of Electrical and Control Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Piotr Kołodziejek	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	15.0	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	10.0	45.0	100

Subject objectives

Knowledge and skills in the fields of hydrodynamical system modeling (CFD) and electric drive design for electric water vehicles : electric jet skis, electric RIBs, houseboat, electric surfboard, surfboard with electric hydrofoil, boats with electric motor. The subject includes the design of drive systems for water vehicles: structure construction, hydrodynamics, propeller motor, gearbox , power supply system, electricl motor, control system, energy storage, safety issues. Autonomous houseboat and RES systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W06] knows the structure of computers and microprocessors and the tasks of operating systems, has basic knowledge of the basics of computer software, drivers, microprocessor technology, design of simple algorithms and the operation of information networks	student justifies choice of the microprocessor unit for the water vehicle drive control system synthesis.	[SW1] Assessment of factual knowledge
[K6_W07] has basic knowledge related to control and automation systems	student selects control system for the water propulsion vehicle.	[SW1] Assessment of factual knowledge
[K6_K05] can think and act in an entrepreneurial way	student selects components of the drive system for determined ship type.	[SK5] Assessment of ability to solve problems that arise in practice
[K6_U04] has the ability to self-educate, among other things, in order to improve professional qualifications	student explains scientific reports needed for the project	[SU1] Assessment of task fulfilment
[K6_W11] knows the hazards arising from devices, installations, systems and technical systems, basic principles of occupational health and safety, taking into account the role of control and security systems in controlling automation and robotics facilities	students determines safe voltage range for electric devices for the water propulsion vehicle.	[SW1] Assessment of factual knowledge

Subject contents	**Lecture.** Introduction, definitions. Classification of electric water vehicles. Innovative water electric vehicles. Buoyancy - hydrostatic calculations, stability, resistance to motion of underwater and surface vehicles - buoyancy, gliding, hydrofoils. Composite technologies. Propellers and jet propellers. Characteristics of propellers and propulsion systems. Cavitation phenomenon. Designing propulsion systems for electric water vehicles: design assumptions, vehicle dynamics, propeller parameters, calculations and motor selection, selection of gearbox type and parameters, power supply system, controller, control system, energy storage, auxiliary systems, safety systems. Elements of a smart autonomous floating house system. **Lab.** Numerical modeling of surface resistance of vehicles and hydrofoil lift (CFD), simulation modeling of propulsion systems with a load model. Simulation modeling of drive systems and load models. Design of an electric propeller. Execution of structural elements using 3D printing technology. Propeller characteristics with fixed and variable pitch propeller. Elements of a smart autonomous floating house system. Computer aided production systems CAD, CAM, CAQ, CIM. Software for intelligent water vehicle systems. **Project.** Project of a small electric personal water vehicle: electric hydrofoil, electric SUP, electric water scooter based on RIB construction, electric outboard motor. CAD design of structural elements, 3D printing, production of small composite elements.
Prerequisites and co-requisites	Basics of electrical engineering, automation and programming.
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture	50.0%	30.0%
Laboratory	50.0%	30.0%
Project	50.0%	40.0%

Recommended reading	Basic literature	1. Abu -Rub H. Guziński J. High Performance Control of AC Drives with Matlab/Simulink John Wiley & Sons 2021 2. Dembowski A,.: Elektryczny napęd trakcyjny. WNT. Warszawa 2019 3. Mathys Charles: Electric Propulsion for Boats, 2010 4. Ray Vellinga: Hydrofoils. Design. Build. Fly. 2009 5. Choromański W., Grabarek I., Kozłowski M., Czerepicki A., Marczuk K.: Pojazdy autonomiczne i systemy transportu autonomicznego. PWN. Warszawa. 2020 6. Ehsani, Y. Gao, S. Longo, K. Ebrahimi: Modern Electric, Hybrid Electric, and Fuel Cell Vehicles Fundamentals, Theory, and Design. M. CRC Press, 3rd Edition, 2018. 7. Polski Rejestr Statków, Rules for Classification and Construction of Sea-going Ships,,Part.II Hull, Gdańsk, 2011.
	Supplementary literature	1. Tobis W.: Budowa i naprawa jachtów z laminatów, 2013
	eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	1. List and describe the types of electric powered water vehicles. 2. Discuss the principles of designing the propulsion system in relation to the type of water vehicle. 3. Select the engine for the vehicle's electric drive and estimate the driving time as a function of vehicle speed. 4. Discuss the characteristics of the propulsor and electric motors as well as the criteria and rules for the selection of their parameters. 5. Discuss the properties of a hydrofoil with an electric propeller. 6. Discuss the systems of a smart autonomous houseboat. 7. Explain the range of applications of PMSM, BLDC, synchronous and squirrel-cage motors in water electric vehicles. 8. How can the hydrodynamic resistance of electric water vehicles be reduced?
Work placement	Not applicable