GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Cogeneration systems, PG_00055954		
Field of study	Power Engineering, Power Engineering, Power Engineering		
Date of commencement of studies	October 2021	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	3	Language of instruction	Polish
Semester of study	5	ECTS credits	5.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Jacek Kropiwnicki	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	15.0	15.0	0.0	0.0	60

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	60	5.0	60.0	125

Subject objectives

Presentation of the latest developments in cogeneration systems using heat engines with particular emphasis on reciprocating engines and Stirling engines, their classification, powering with alternative fuels, energy management in complex cogeneration systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W09] knows the dangers of electrical devices and the principles of protection against them, has basic knowledge of heat exchangers, has basic knowledge of power equipment such as pumps, compressors, turbines, combustion engines, boilers, pipelines and their accessories and methods of their selection depending on the needs	Can analyse and evaluate the methods of functioning of the heat engines, understands the specificity of propulsion systems, understands the consequences of the selected solutions in terms of achieved energetics parameters of the system.	[SW1] Assessment of factual knowledge
[K6_U06] is able to use the basic knowledge on the operation of energy equipment in the field of thermal power plants, thermal and energy and heating systems, combustion engines, compressors and rotating machines to assess the technical condition of the system	Can use modern tools and knowledge in designing, operating and components selecting of combined heat and power systems.	[SU1] Assessment of task fulfilment
[K6_W13] has basic knowledge of the operation of energy equipment in the field of thermal power plants, thermal and energy and heating systems, internal combustion engines, compressors and rotating machines, has basic knowledge of the regulation of energy equipment and methods of their selection depending on the needs	Student is able to characterize the technologies used in the combined heat and power systems. Student is able to assess the suitability of each technology and devices in different energy systems. He knows the rules for the selection of the main sources of energy and knows how to combine cooperation of various energy sources.	[SW1] Assessment of factual knowledge

Subject contents	**Lecture:** General information about heat engines, their structure and properties, characteristics, modelling of the work cycle, mechanical and thermal loads, mechanics of the crank system, balancing, calculation and design of the flywheel, analysis of the structure of the main components of engines, strength calculations, bearings of engines, fuels, fuel and ignition systems, solutions for energy systems, electronic diagnostics of engines, energy management in complex cogeneration systems. **Tutorials:** Work cycle modelling, device initial calculations, crank system mechanics, strength calculations, energy analysis, calculations of propulsion systems. **Laboratory:** Construction and identification of heat engine components, measurements of the basic parameters of heat engines, testing of power supply components and electronic diagnostics of engines, supply, ignition systems and electronic diagnostics of engines, start-up and shutdown of the Stirling engine.
Prerequisites and co-requisites	

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratories	90.0%	10.0%
Tutorials	50.0%	40.0%
Lecture	50.0%	50.0%

Recommended reading

Basic literature	Wajand J.A., Wajand J.T.: Tłokowe silniki spalinowe średnio- i szybkoobrotowe. WNT. Kropiwnicki J. Modelowanie układów napędowych pojazdów z silnikami spalinowymi. AGNI. Żmudzki S.: Silniki Stirlinga. WNT. Skorek J., Kalina J.: Gazowe układy kogeneracyjne. Wydawnictwa Naukowo-Techniczne Klimstra J., Hotakainen M.: Smart Power Generation: The Future of Electricity Production. Avain Publishers Ghosh T.K., Prelas M.A.: Energy Resources and Systems. Springer Dordrecht Heidelberg London New York.
Supplementary literature	http://www.combustion-engines.eu https://www.sciencedirect.com/journal/energy
eResources addresses	

Example issues/ example questions/ tasks being completed	Draw a kinematic scheme of four stroke high speed engine. Name the methods of forced induction (charging) and their advantages and weaknesses, draw a scheme of turbocharger connected to an engine. Calculate the change in net power of the Stirling engine after replacing the working medium from helium to air. Discuss the principles of selection of combined heat and power units.
Work placement	Not applicable