



## 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 2022	Academic year of realisation of subject			2024/2025		
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	Zakład Ekoinżynierii i Silników Spalinowych -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Jacek Kropiwnicki				
	Teachers		dr inż. Denys Stepanenko dr hab. inż. Zbigniew Kneba dr hab. inż. Jacek Kropiwnicki				
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_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
	[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_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
Subject contents	<p><b>Lecture:</b> 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.</p> <p><b>Tutorials:</b> Work cycle modelling, device initial calculations, crank system mechanics, strength calculations, energy analysis, calculations of propulsion systems.</p> <p><b>Laboratory:</b> 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.</p>		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Lecture	50.0%	50.0%
	Tutorials	50.0%	40.0%
	Laboratories	90.0%	10.0%
Recommended reading	Basic literature	<p>Wajand J.A., Wajand J.T.: Tłokowe silniki spalinowe średnio- i szybkoobrotowe. WNT.</p> <p>Kropiwnicki J. Modelowanie układów napędowych pojazdów z silnikami spalinowymi. AGNI.</p> <p>Żmudzki S.: Silniki Stirlinga. WNT.</p> <p>Skorek J., Kalina J.: Gazowe układy kogeneracyjne. Wydawnictwa Naukowo-Techniczne</p> <p>Klimstra J., Hotakainen M.: Smart Power Generation: The Future of Electricity Production. Avain Publishers</p> <p>Ghosh T.K., Prelas M.A.: Energy Resources and Systems. Springer Dordrecht Heidelberg London New York.</p>	

	Supplementary literature	<a href="http://www.combustion-engines.eu">http://www.combustion-engines.eu</a>  <a href="https://www.sciencedirect.com/journal/energy">https://www.sciencedirect.com/journal/energy</a>
	eResources addresses	Adresy na platformie eNauczanie: Układy kogeneracyjne, W,Ć,L, Energetyka I, sem. 05, zimowy 24/25 (PG_00055954) - Moodle ID: 40357 <a href="https://enauzanie.pg.edu.pl/moodle/course/view.php?id=40357">https://enauzanie.pg.edu.pl/moodle/course/view.php?id=40357</a>
Example issues/ example questions/ tasks being completed	<p>Draw a kinematic scheme of four stroke high speed engine.</p> <p>Name the methods of forced induction (charging) and their advantages and weaknesses, draw a scheme of turbocharger connected to an engine.</p> <p>Calculate the change in net power of the Stirling engine after replacing the working medium from helium to air.</p> <p>Discuss the principles of selection of combined heat and power units.</p>	
Work placement	Not applicable	

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