



Subject card

Subject name and code		Mathematical modelling of energy plants, PG_00057258						
Field of study		Power Engineering, Power Engineering, Power Engineering						
Date of commencement of studies		February 2023	Academic year of realisation of subject			2022/2023		
Education level		second-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		1	Language of instruction			Polish		
Semester of study		1	ECTS credits			3.0		
Learning profile		general academic profile	Assessment form			assessment		
Conducting unit		Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)		Subject supervisor		dr inż. Paweł Ziółkowski				
		Teachers		dr hab. inż. Tomasz Muszyński dr inż. Paweł Ziółkowski				
Lesson types and methods of instruction		Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
		Number of study hours	30.0	0.0	15.0	0.0	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		20.0	75	
Subject objectives		mathematical modelling fundamentals and methods of technical processes and installations						
Learning outcomes		Course outcome		Subject outcome		Method of verification		
		[K7_W05] knows basic methods, techniques and tools used in solving complex engineering tasks in the field of modeling of thermal-energy systems		student is able to transform technical problem into mathematical model, applies appropriate mathematical simulation methods		[SW3] Assessment of knowledge contained in written work and projects [SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge		
		[K7_U02] is able to use known mathematical and numerical methods to analyze and design elements, systems and power transmission networks and internal installations		student is able to theoretically and experimentally formulate mathematical model of technical problem, is conscious of the role and apply mathematical model linearization, knows standard mathematical models, can adapt standard mathematical model to the technical problem		[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information		
		[K7_W01] has extended and deepened knowledge of mathematics indispensable for describing phenomena related to processes of energy conversion and transfer; uses advanced information technologies		student knows mathematical model identification methods, is conscious of the role of mathematical model sensibility, knows and is conscious of the role of CFD and Matlab		[SW1] Assessment of factual knowledge		
		[K7_U03] has the necessary preparation to work in an industrial environment, is prepared to undertake third degree studies, applies the principles of safety and hygiene		student is able to mathematically formulate problems of energetical installations, can decompose complex mathematical models		[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment		

Subject contents	<p>content of the lecture:</p> <p>Expanding information on thermodynamic cycles and expanding information on modelling them using commercial tools. Presentation of balances, constitutive equations, how to specify conditions in CFD type codes. Regulation and control of equipment in the context of heat exchangers.</p> <p>laboratory content:- processing and visualisation of experimental data of systems and equipment, (6 h)- modelling and optimisation of steady state power generation system (5h),- modelling of dynamic states of energy devices (4h)</p>		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	lecture - examination	50.0%	50.0%
	practical exercise - midterm tests	50.0%	50.0%
Recommended reading	Basic literature	<p>1: Stephen Turns: Thermal-Fluid Sciences an integrated approach. Cambridge University Press, New York 2006.</p> <p>2: Wolfgang Altmann: Practical process control for engineers and technicians. Newnes, Oxford 2005.</p> <p>3: Rolf Kehlhofer: Combined-cycle gas & steam turbine power plant. The Fairmont Press, Lilburn, 1991.</p> <p>4: Janusz Badur (2005): Pięć wykładów ze współczesnej termomechaniki płynów. 2005 www.imp.gda.pl/fileadmin/doc/o2/z3/.../2005_piecwykladow.pdf, Gdańsk.</p> <p>5: Janusz Badur (2003): Numeryczne modelowanie zrównoważonego spalania w turbinach gazowych. Wydawnictwo IMP PAN, Gdańsk</p> <p>6: Olgierd C. Zienkiewicz (1972): Metoda elementów skończonych. Arkady, Warszawa.</p>	
	Supplementary literature	<p>1. Jackson L.B.: Signals, Systems and Transforms. Adison Wesley, Boston, 1991</p> <p>2. P. Ziółkowski, J. Badur, P.J. Ziółkowski: An energetic analysis of a gas turbine with regenerative heating using turbine extraction at intermediate pressure - Brayton cycle advanced according to Szewalski's idea. Energy 185 (2019) 763-786.</p> <p>3. P. Ziółkowski, J. Badur: On Navier slip and Reynolds transpiration numbers. Archive of Mechanics. 70, 3, pp. 269300, Warszawa 2018</p>	
	eResources addresses	<p>Adresy na platformie eNauczanie:</p> <p>Modelowanie matematyczne instalacji energetycznych, PG_00057258 - Moodle ID: 30417 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30417</p>	
Example issues/ example questions/ tasks being completed	<p>Mass, momentum and energy conservations in 0D and 3D aproach, role of mathematical modelling, mathematical modelling principles, theoretical and empirical modelling, model parameter evaluation, different types of mathematical models, role of mathematical models equivalence, reason for mathematical model linearization, role of mathematical model sensibility,</p>		
Work placement	Not applicable		