



Subject card

Subject name and code	Automation of welding processes, PG_00056118						
Field of study	Mechatronics						
Date of commencement of studies	October 2024	Academic year of realisation of subject				2026/2027	
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				2.0	
Learning profile	general academic profile	Assessment form				assessment	
Conducting unit	Institute of Manufacturing and Materials Technology -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Grzegorz Rogalski					
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	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	30	0.0		0.0	30	
Subject objectives	The aim of the course is to familiarize students with the current state of knowledge in the field of automation of welding processes and related and accompanying elements.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_W08] knows and understands design and production processes of elements and simple mechatronic devices	Students are able to design mechanized and robotic welding stations, taking into account welding power sources and auxiliary equipment.			[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation		
	[K6_W10] has a basic knowledge about development trends in the field of engineering and technology sciences and scientific disciplines: Mechanical Engineering, Automation, Electronics, Electrical Engineering and Space Technologies, adequate for Mechatronics course	Students will learn about new technical solutions in the field of controlling automated and robotic welding processes, support systems, programming robotic stations, and auxiliary equipment.			[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation		
	[K6_U05] is able to use properly chosen tools to compare design solutions of elements and mechatronics systems according to given application and economic criteria (e.g. power demand, speed, costs)	Students will be able to select key welding process variables to increase efficiency, reduce costs, and maintain product quality. Students will be able to design an appropriate automated welding system to meet the needs of the structure.			[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools		
	[K6_U06] is able to identify and formulate specification of simple, practical engineering tasks, distinctive for mechatronics	Students can identify the fundamental variables of welding processes that can be automated and determine their impact on increasing the productivity and quality of welded joints. They can use mechatronic tools to achieve this goal.			[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools		

Subject contents	<p>Course content – lecture</p> <p>In this course, students will learn about the automation and robotization of welding processes. They will become familiar with the current state of knowledge in the field of welding power sources (converters, rectifiers, transformers, inverters). Laser welding sources based on solids, gases, fibers, and semiconductors are discussed. Students will become familiar with the instrumentation and requirements for these peripherals. They will learn how to increase welding efficiency through the use of automated systems, including industrial and collaborative robots. Examples of welding, heating, soldering, and gluing automation are presented. Students will learn about the differences in programming collaborative and industrial robots with applications dedicated to welding and other welding processes (welding functions such as weave, arc tracking, weldment recognition, arc length compensation, and others are discussed). Elements supporting the automation, monitoring, and data archiving process are presented, including integrated systems for archiving data on essential process variables, vision systems, specialized cameras for real-time observation of welding processes, complex systems with feedback, and others. Processes supporting the development of welding processes in the virtual world are also presented (offline programming, building virtual stations, offline testing).</p>											
	<p>Course content – laboratory</p> <p>Additional labs are lecture-based. They cover the following topics: 1. Introduction to laboratory descriptions, including a discussion of occupational health and safety regulations in the laboratory and access to occupational safety using automated systems, including industrial and collaborative robots. 2. Design and characteristics of electric power sources for welding equipment in welding automation. This covers systems such as MIG/MAG (including FCAW and MCAW), TIG, PAW, and SAW. Discussion of additional accessories and equipment specific to a specific process. Characteristics of laser power sources. Design of a device for electric resistance welding. 3. Comparison of MMA welding equipment with SAW automatic welding. The relationship between basic process variables and weld joint geometry. Combustion efficiency parameters and their potential applications in production and large-scale production. 4. Comparison of MAG and FCAW configurations. The relationship between basic process variables and the geometry of welded joints. Performance parameters of both devices in relation to their automation capabilities, including robotization. 5. Construction of a robotic station for laser beam feeding and the influence of laser parameters on the geometry of welds in parts I and II. 6. Possibilities of generating TIG current using an electric power supply. Comparison with manual welding and specific differential devices for both devices. 7. In the automation of resistance welding devices and the arc welding process.</p>											
Prerequisites and co-requisites	Basic knowledge of welding processes											
Assessment methods and criteria	<table border="1"> <thead> <tr> <th>Subject passing criteria</th> <th>Passing threshold</th> <th>Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Laboratory</td> <td>56.0%</td> <td>50.0%</td> </tr> <tr> <td>Lecture</td> <td>56.0%</td> <td>50.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Laboratory	56.0%	50.0%	Lecture	56.0%	50.0%
	Subject passing criteria	Passing threshold	Percentage of the final grade									
	Laboratory	56.0%	50.0%									
Lecture	56.0%	50.0%										
Recommended reading	<p>Basic literature</p> <p>Dobaj E.: Maszyny i urządzenia spawalnicze, WNT Wydawnictwa Naukowo-Techniczne, 2014</p> <p>Pilarczyk J.: Poradnik inżyniera Spawalnictwo Tom 1, Tom 2 Wydanie II, Wydawnictwo: Naukowe PWN, 2017</p> <p>Chmielewski T.: Projektowanie procesów technologicznych spawalnictwo, Oficyna Wydawnicza Politechniki Warszawskiej, 2013</p> <p>Klimpel A.: Technologie laserowe w spawalnictwie, Wydawnictwo Politechniki Śląskiej, Gliwice, 2011</p> <p>Ferenc K.: Podręcznik spawania. Zagadnienia ogólne. Agencja Wydawnicza SIMP, 2018</p>											
	Supplementary literature		None									
	eResources addresses											
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> 1. Give the methods of increasing the efficiency of the MIG / MAG welding process using robotic welding 2. Give the methods of automation and robotization of welding with the TIG process 3. Explain the principles of building robotic stations with the observance of safety rules 4. Provide the methods of manipulating the object welded on the robotic station 5. Suggest a method of fixing pipe elements on a mechanized TIG welding stand 6. What are the welding positioners for, provide typical solutions 											

Practical activities within the subject	Not applicable
---	----------------

Document generated electronically. Does not require a seal or signature.