

Subject name and code	Functional Materials						
Field of study	Electrical and Control Engineering						
Level of studies	postgraduate studies	Type of subject			Elective		
Mode of study	Full-time studies	Mode of delivery			At the university		
Year of study	1	Language of instruction			English		
Semester of study	2	ECTS credits			4.0		
Learning profile	General academic profile	Assessment form			Assessment		
Conducting unit	Department of Mechatronics and High Voltage Engineering, Faculty of Electrical and Control Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor		Arkadiusz Żak, MSc, PhD, DSc, Associate Professor				
	Teachers		Arkadiusz Żak, MSc, PhD, DSc, Associate Professor Wiktor Waszkowiak, MSc, PhD				
Lesson type and method of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	15.0	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		3.0		67.0	100
Subject objectives	Get basic knowledge and skill on functional materials and their applications in modern engineering practice/						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	K_W05 Proszę wybrać efekt kształcenia z wiedzy i umiejętności. Efekty zostaną przetłumaczone na j. angielski						
	K_U08						
	K_U01						

Subject contents	<p><b>Lectures</b></p> <p>During the course students will learn about different classes of intelligent materials and a strong emphasis will be placed on their practical use in modern technologies. The course is planned to embrace both scientific and technical knowledge about functional materials that will allow students to understand their behaviour leading to present and possible future applications. The course is divided into 2 consistent modules and also includes a general introduction lecture to the subject of functional materials. The first module, embraces information and lectures on: electrostrictive materials, magnetostrictive materials, piezoelectric materials, shape memory materials. The second module embraces information and lectures on: electrorheological fluids, magnetorheological fluids, nanotechnology and metamaterials as well as novel smart composites.</p>		
Prerequisites and co-requisites	Basic knowledge on material science		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Final test	60.0%	50.0%
	Project	60.0%	50.0%
Recommended reading	Basic literature	Y. Dahman: <i>Nanotechnology and Functional Materials for Engineers</i> , Elsevier, 2017	
	Supplementary literature	M. P. Cartmell, A. J. Žak, O. Ganilova: <i>Applications for shape memory alloys in structural and machine dynamics</i> , <i>Nonlinear Dynamic Phenomena in Mechanics</i> , 115-158, 2012	
	eResources addresses		
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> <li>1. electrostrictive &amp; magnetostrictive materials,</li> <li>2. piezoelectric materials,</li> <li>3. shape memory materials.</li> <li>4. electrorheological &amp; magnetorheological fluids,</li> <li>5. metamaterials,</li> <li>6. novel smart composites.</li> </ol>		
Work placement	Not applicable		