



## COURSE CARD

### 1. Basic information

Course name in English:	Microsystems and Microengineering	
Course name in Polish:	Mikrosystemy i Mikroinżynieria	
Number of hours:	30	
Type of course:	Elective course	
Form of course:	lecture	
Code of course:	...	
Course leader:	Prof. Rafał Walczak	
Faculty of the course leader:	W12 Faculty of Electronics, Photonics and Microsystems	
Email address of the course leader:	rafal.walczak@pwr.edu.pl	
Scientific discipline(s) assigned to the course (doctoral students representing the marked disciplines can participate in the course):	Architecture and urban planning	<input type="checkbox"/>
	Automation, electronic, electrical engineering and space technologies	<input checked="" type="checkbox"/>
	Information and communication technology	<input checked="" type="checkbox"/>
	Biomedical engineering	<input type="checkbox"/>
	Chemical engineering	<input type="checkbox"/>
	Civil engineering, geodesy and transport	<input type="checkbox"/>
	Materials engineering	<input type="checkbox"/>
	Mechanical engineering	<input type="checkbox"/>
	Environmental engineering, mining, and energy	<input type="checkbox"/>
	Mathematics	<input type="checkbox"/>
	Chemical sciences	<input type="checkbox"/>
	Physical sciences	<input type="checkbox"/>
	Management and quality studies	<input type="checkbox"/>

### 2. Objectives

Familiarizing with the newest technical and technological trends related to microsystems and microengineering

Analyse and discussion about actual and developing fields of application of microsystems in research and industry.

### 3. Content

*Detailed information about the course content, including topics and form of classes.*

No.	Topic	Number of hours	Form of classes
1	Introduction to microsystems (MEMS)		lecture
2	Microengineering in mems technique		lecture



3	3D printing for MEMS		lecture
4	4D printing		lecture
5	Printed electronics		lecture
6	Automotive microsystems		lecture
7	Analytical microsystems		lecture
8	Microsystems for medicine		lecture
9	Optical microsystems		lecture
10	Micromechatronics and micromachines		lecture
11	MEMS for energy harvesting		lecture
12	MEMS for IoT and Industry 4.0		lecture
13	Vacuum MEMS		lecture
14	Space MEMS		lecture
15	Review of worldwide market of microsystems		lecture

#### 4. Prerequisites

*List of prerequisites relating to knowledge, skills and other competences for course participants.*

Knowledge about state-of-the-art and new trends of modern electronics and microsystems technique. Ability to improve competences in interdisciplinary fields of science and research

#### 5. Learning outcomes

*List of learning outcomes at level 8 of the Polish Qualifications Framework assigned to the course (mark the learning outcomes in the last column).*

Symbol	Learning outcome	
	<b>KNOWLEDGE. Doctoral student knows and understands:</b>	
SzD_W3	the main trends in the development of the scientific or artistic disciplines covered in the curricula;	<input checked="" type="checkbox"/>
SzD_W4	research methodology;	<input type="checkbox"/>
SzD_W5	the rules for the dissemination of scientific results, including in open access mode;	<input type="checkbox"/>
SzD_W6	the fundamental dilemmas of modern civilization;	<input type="checkbox"/>
SzD_W7	the legal and ethical conditions of scientific activity;	<input type="checkbox"/>
SzD_W8	the economic and other relevant conditions of scientific activity;	<input checked="" type="checkbox"/>
SzD_W9	basic principles of knowledge transfer to the economic and social spheres and commercialisation of results of scientific activity and know-how related to these results.	<input type="checkbox"/>
	<b>SKILLS. Doctoral student is able to:</b>	
SzD_U2	use knowledge from different fields of science or art to creatively identify, formulate and innovatively solve complex problems or perform research tasks, in particular: - define the purpose and subject of scientific research, formulate a research hypothesis, - develop research methods, techniques and tools, and use them creatively,	<input checked="" type="checkbox"/>



	- draw conclusions on the basis of scientific research; critically analyse and evaluate the results of scientific research, expertise and other creative work and their contribution to knowledge development; transfer the results of scientific activities to the economic and social spheres;	
SzD_U3	communicate on specialised topics to the extent that they enable an active participation in the international scientific community;	<input checked="" type="checkbox"/>
SzD_U4	disseminate research results, including in popular forms;	<input checked="" type="checkbox"/>
SzD_U5	initiate debates and participate in a scientific discourse;	<input type="checkbox"/>
SzD_U6	be able to speak a foreign language at B2 level of the Common European Framework of Reference for Languages to a level that enables them to participate in the international scientific and professional environment;	<input checked="" type="checkbox"/>
SzD_U7	plan and implement an individual or collective research or creative activity, including in an international environment;	<input checked="" type="checkbox"/>
SzD_U8	independently plan and act for one's own development and inspire and organize the development of others;	<input type="checkbox"/>
SzD_U9	plan classes or groups of classes and implement them using modern methods and tools.	<input type="checkbox"/>
	<b>SOCIAL COMPETENCES. Doctoral student is ready to:</b>	
SzD_K3	fulfilling the social obligations of researchers and creators, initiate public interest activities, thinking and acting in an entrepreneurial way;	<input checked="" type="checkbox"/>
SzD_K4	maintaining and developing the ethos of research and creative environments, including: - carrying out scientific activities in an independent manner, - respecting the principle of public ownership of research results, taking into account the principles of intellectual property protection.	<input checked="" type="checkbox"/>

## 6. Evaluation

*Short description of the method(s) used to evaluate the learning outcomes assigned to the course, e.g., exam, test, report, presentation, etc.*

Individual final written work (2 page in the form of conference abstract) on potential application of microsystems in students research works.

## 7. Teaching methods

*Short description of the teaching methods used during the course, e.g., multimedia presentation, discussion, literature studies, developing written documents, own work, etc.*

Multimedia presentation followed with discussion on the lectures subjects.

## 8. Literature

*List of primary and secondary literature used to prepare the course and including additional knowledge for participants, e.g., books, textbooks, research papers, standards, web pages, etc.*

R. Walczak, Laboratoria chipowe z detekcją optyczną, konstrukcja, technologia i przykłady wykorzystania, Oficyna Wydawnicza PWr, 2014



Scientific journals in the field: Journal of Micromechanics and Microengineering, Sensors and Actuators A/B, LabChip Journal, Micromachines, BioChip Journal etc

## 9. Other remarks

*Additional remarks, comments, (e.g., language of the course)*

Language of the course – English.