

**DOCTORAL SCHOOL OF WROCLAW UNIVERSITY OF SCIENCE AND  
TECHNOLOGY**

SUPERVISOR/TEAM/ DECLARING/CONDUCTING COURSE: dr hab. inż. Sergiusz Patela,  
Prof. Uczelni / dr hab. inż. Damian Pucicki, Prof. Uczelni  
DEPARTMENT W-12 (Z9/Z3)

**COURSE CARD**

**Course name in Polish:** Zaawansowane struktury fotoniki

**Course name in English:** Advanced photonics structures

**Course language Polish / ~~English~~ (Option, if foreigners appear in the lecture)**

**Specialized courses for PhD students receiving education in  
discipline:** Automation, Electronics and Electrical Engineering

**Subject code:** AEQ100152W

\* delete as applicable

	Lecture	Foreign language course	Seminar	Mixed forms
Number of hours of organized classes in university (ZZU)	30			
Grading	Exam	Exam	Oral presentation	Exam, inspection, evaluation classes

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge in physics and mathematics at the level of I / II studies
2. Solid state physics

**COURSE OBJECTIVES**

- C1 Presentation both the physical phenomena which rules the operation of nowadays photonics devices as well basis of their fabrication methods.
- C2 Discussion of selected areas of application of advanced photonics devices with particular emphasis on optical communication.

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**PROGRAM CONTENTS**

<b>Form of classes – lecture (Lec)</b>		<b>Number of hours</b>
Lec1	Selected aspects of semiconductor devices technology, including: modes of epitaxial growth, selective area epitaxy, anisotropy of epitaxy, aerotaxy, types of epitaxial quantum structures, structural characterization.	4
Lec2	Properties of quantum structures: band and electronic structure, light-matter interaction in low-dimensional structures.	4
Lec3	Structures, technology and properties of advanced optoelectronic devices: technological and structural limitations, stress-balanced structures, electro-optic modulation in semiconductor devices.	4
Lec4	Advanced semiconductor light sources and photodetectors.	3
Lec5	Fundamentals of construction and technology of advanced photonics structures: fiber modulators and multiplexers, integrated photonics systems.	4
Lec6	Fundamentals of nonlinear optics: classification and description of non-linear optical phenomena, use of optical non-linearity in photonics, properties and technology of photonic crystals.	2
Lec 7	Photonic crystals: theoretical description and technology.	3
Lec 8	Present day optical communication: devices and systems.	2
Lec 9	Silicon photonics.	2
Lec10	Plasmonics	2
<b>Total hours:</b>		<b>30</b>

**TEACHING TOOLS USED**

- N1. E-portal
- N2. Traditional lecture supported by the multimedial presentation, discussion and exhibition of chosen semiconductor devices.
- N3. Short oral presentations of selected subjects performed by students with discussion and comments of teacher.

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<b>ACHIEVED SUBJECT LEARNING OUTCOMES</b>		
Type of learning outcome	Code of learning outcome	Assessment of learning outcome
Knowledge	P8U_W	Competently quotes other authors in articles prepared for publication and in the doctoral dissertation.
	P8S_WG	Has advanced knowledge of a basic nature for the field related to the area of research, including the latest methods of research and verification of achieved results.
Skills	P8U_U	Has knowledge about the up to date list of active scientific journals included in the Scopus and Web of Science databases, together with the disciplines assigned to them, specified in the new classification of fields and disciplines.
	P8S_UW	Has scientific skills related to the methods and methodology of conducting scientific research and a critical assessment of the obtained results.
Social competence	P8U_K	He knows what is the activity leading to the creation of scientific achievements in violation of law, including copyright or decency in science, and that is the basis for the resumption of the proceedings for the award of the degree of doctor or habilitated doctor or the title of professor.
	P8S_KK	Is aware of the role of cooperation, including international cooperation, in the process of carrying of research and analyzing of achieved results.

<b>PRIMARY AND SECONDARY LITERATURE</b>
<p><b><u>PRIMARY LITERATURE:</u></b></p> <p>[1] State of the art scientific literature presenting the issues discussed at the lecture.</p> <p>[2] D. Pucicki, <i>Quantum structures in technology of semiconductor devices</i>, Printing House of Wrocław University of Science and Technology Wrocław 2017, (in Polish)</p>
<p><b><u>SECONDARY LITERATURE:</u></b></p> <p>[3] J. D. Joannopoulos, <i>Photonic crystals: molding the flow of light</i>. Princeton: Princeton University Press, 2008.</p> <p>[4] M. C. Gupta and J. Ballato, <i>The handbook of photonics</i>. CRC press, 2012</p>
<p><b>SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)</b></p> <p>Sergiusz Patela, Sergiusz.Patela@pwr.edu.pl</p> <p>Damian Pucicki, Damian.Pucicki@pwr.edu.pl</p>