Warsaw University
of Technology

COURSE OFFERED IN THE DOCTORAL SCHOOL

Code of the course	4606-ES-000000L-0300	Name of the course	Polish	**Techniki terahercowe**	
			English	**Terahertz Technology**	
Type of the course	specialized				
Course coordinator	Dr hab. Agnieszka Siemion		Course teacher	Dr hab. Agnieszka Siemion	
Implementing unit	Faculty of Physics	Scientific discipline / disciplines*	Physical sciences		
Level of education	Doctoral studies	Semester	winter		
Language of the course	~~Polish~~/English				
Type of assessment	Final grade	Number of hours in a semester	30	ECTS credits	2
Minimum number of participants	10	Maximum number of participants	30	Available for students (BSc, MSc)	Yes/~~No~~

Type of classes		Lecture	Auditory classes	Project classes	Laboratory	Seminar
Number of hours	in a week					
	in a semester	15		15		

* does not apply to the Researcher's Workshop

1. Prerequisites

Basics of optics and solid state physics.

2. Course objectives

The aim of the course is to familiarize students with the basic knowledge of terahertz radiation. It covers issues such as its generation and detection, illustrates the design and manufacturing process of THz optical elements. The understanding of the methods of THz beam shaping and the ability to indicate the application of this radiation in practice.

3. Course content (separate for each type of classes)

Lecture

Lecture:
- What is THz radiation?
- brief history;
- generation of THz radiation
- different types of THz sources and their characteristic features;
- detection of THz radiation;
- narrow- and broadband sources and detectors;
- terahertz spectroscopy;
- shaping of THz beams;
- THz components
- measurement systems
- application of THz technique.

Project:
- application of THz technique;
- most recent achievements in the THz field.

Laboratory

4. Learning outcomes			
Type of learning outcomes	Learning outcomes description	Reference to the learning outcomes of the WUT DS	Learning outcomes verification methods*
Knowledge			
K01	Has a structured and theoretically supported knowledge of terahertz radiation, its generation and detection, THz optical elements, THz beamforming and its applications.	SD_W2	test
K02	Has the basic knowledge of applied optics for THz radiation necessary to understand the potential applications.	SD_W3	test
K03	Has theoretically underpinned knowledge to understand the relationships between the performance of various types of sources and detectors of THz radiation.	SD_W3	test project evaluation
K04	Is familiar with the current status and latest development trends of terahertz technology.	SD_W3	test project evaluation
Skills			
S01	Can obtain information from literature, databases and other sources; can integrate obtained information, interpret it, and formulate and justify opinions.	SD_U2	project evaluation
S02	Can explain, using the relevant principles and methods of physics and mathematical tools, the basic regularities, phenomena and physical processes and analytically describe the physical laws and equations governing them.	SD_U1	test
S03	Can prepare and present a short description dedicated to the results of the project task.	SD_U2	project evaluation
Social competences			
SC01	Is aware of the responsibility for his own work and is ready to conform to the rules of teamwork and take responsibility for jointly implemented tasks.	SD_K3	project evaluation
SC02	Is able to appropriately identify priorities to achieve a defined task.	SD_K5	test project evaluation

*Allowed learning outcomes verification methods: exam; oral exam; ; oral test; project evaluation; report evaluation; presentation evaluation; active participation during classes; homework; tests

5. Assessment criteria
Final grade is the average calculated from the lecture and project. Lecture is completed after passing the final test.

6. Literature
Primary references:

[1] Yun-Shik Lee, Principles of Terahertz Science and Technology, Springer 2009

[2] A. Rostami, H. Rasooli, H. Baghban, „Terahertz Technology", Springer

[3] D. Saeedkia, „Handbook of Terahertz Technology for Imaging, Sensing and Communications", Woodhead Publishing Series in Electronic and Optical Materials

[4] J. L. Coutaz, F. Garet and V.P. Wallace, "Principles of Terahertz time-domain spectroscopy: an introductory textbook," CRC Press, 2018.

7. PhD student's workload necessary to achieve the learning outcomes**		
No.	Description	Number of hours
1	Hours of scheduled instruction given by the academic teacher in the classroom	15h lectures and 15h project
2	Hours of consultations with the academic teacher, exams, tests, etc.	5h consultation, 1h allocated for test and 1h for discussion of project works
3	Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework	Preparation for lectures 5h, project preparation 10h
4	Amount of time devoted to the preparation for exams, test, assessments	Preparing for the test - 5h
	Total number of hours	**42h + 20h**
	ECTS credits	**2**

** 1 ECTS = 25-30 hours of the PhD students work (2 ECTS = 60 hours; 4 ECTS = 110 hours, etc.)

8. Additional information	
Number of ECTS credits for classes requiring direct participation of academic teachers	2
Number of ECTS credits earned by a student in a practical course	2