Warsaw University of Technology

COURSE OFFERED IN THE DOCTORAL SCHOOL

Code of the course	234A-KDAN-RPFE	Name of the course	Polish	**Szybkie Eksperymentowanie**
			English	**Rapid Prototyping for Experiments**
Type of the course	Researcher's Workshop			
Course coordinator	M.Eng. Andrzej Manujło			
Course teacher	M.Eng. Andrzej Manujło, M.Eng. Aleksandr Gnat			
Implementing unit		Scientific discipline / disciplines*		

Level of education	Doctoral Program	Semester	Winter and summer semesters		
Language of the course	English				
Type of assessment:	Z (zaliczenie)	Number of hours in a semester	30	ECTS credits	2
Minimum number of participants	10	Maximum number of participants	12	Available for students (BSc, MSc)	Yes

Type of classes		Lecture	Auditory classes	Project classes	Laboratory	Seminar
Number of hours	in a week					
	in a semester			6	24	

* does not apply to the Researcher's Workshop

1. Prerequisites

The module was prepared to meet the needs of PhD students who have no eprinece (at the earlier stages of education) in rapid prototyping techniques (3D printing, Arduino platform, Micropython and MIT Processing). Classes are conducted at the basic level, but knowledge of such concepts as: loop, conditional statement, array, variable and function is required. Knowledge of any specific programming language and graphic programs for 3D design is not required. During the classes will be provided tutorials about functions and how to use all the tools necessary to complete the tasks will be discussed. For participants who are not familiar with programming in C ++ or Python, materials will part of their homework, and will allow them to acquire the necessary knowledge and skills to perform laboratory exercises and the final project. Project topics related to the needs of the laboratory or doctoral student's research will be offered, but it will also be possible to build a device from the list of topics proposed by the teacher.

2. Course objectives

Rapid prototyping is used at universities around the world to prepare research equipment and devices for conducting experiments. The acquisition of basic knowledge about the Arduino, MicroPython and Processing platforms will allow PhD students to better implement innovative research. In turn, the aspects related to Design Thinking are important from the point of view of preparing solutions tailored to human needs.

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

Laboratory

Arduino is Open-source electronic prototyping platform enabling users to create interactive electronic objects. It is often successfully used for learning programming as well as for the preparation of experiments and measuring stations.
As part of the workshop, you will learn to program a board and use basic sensors from scratch. 3D printing is increasingly used in research and development.
As part of the modeling and 3D printing classes, you will learn the basic issues and also print your first objects in FDM technology. Classes also include workshops on the basics of 3D design.

Project

Construction and programming of a prototype of a simple device supporting research in the laboratory or the presentation of results, application or system using ready-made libraries for Arduino, MicroPython or Processing.

4. Learning outcomes			
	Learning outcomes description	Reference to the learning outcomes of the WUT DS	Learning outcomes verification methods*
Knowledge			
K01	The participant will be introduced to the innovative techniques of rapid prototyping and experiment planning, which are necessary for the effective conduct of research.	SD_W4	active participation during classes
Skills			
S01	The participant will be introduced to the tools related to rapid prototyping, enabling solving research problems in an innovative way.	SD_U1	active participation during classes
S02	The participant will learn the tools related to the planning of the experiment in order to optimize the research process.	SD_U7	active participation during classes
S03	The participant will learn about the Arduino, Processing, MicroPython platforms and 3D printing technology in order to be able to use them while conducting innovative design classes for students.	SD_U9	project evaluation
Social competences			
SC01	The participant, thanks to the knowledge of the Design Thinking method, will pay more attention to the human factor and social aspects when designing his research and solutions during implementation works.	SD_K3	presentation evaluation
SC02	During the design work, the participant will learn and apply the techniques of rapid prototyping tools for creative solving of research problems. Additionally, during the Design Thinking workshops, he will learn methods for generating new ideas used in leading companies in the world.	SD_K4	project evaluation

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

5. Assessment criteria
• attendance, • implementation of the project, • performing tasks during workshop activities.

6. Literature
[1] Casey Reas, Ben Fry, Processing, MIT Press, 2014.
[2] Thyagaraju, Gowda, Quick Revision Hand Book Programming in C and Data Structures, 2015.
[3] Jesse Harrington Au , 3D CAD I Autodesk 123D, Emily Gertz, Helion, 2016.

7. PhD student's workload necessary to achieve the learning outcomes**		
No.		Number of hours
1	Participation in laboratories and workshops	24
2	Preparation of the participant for laboratories and workshops	16

3	Preparation of the final project (including design and presentation)	20
	Total number of hours	**60**
	ECTS credits	**2**

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