Warsaw University of Technology

COURSE OFFERED IN THE DOCTORAL SCHOOL

Code of the course	4606-ES-00000GH-0160	Name of the course	Polish	**Zastosowania inżynierii materiałowej w diagnostyce urządzeń przemysłowych**
			English	**Applications of materials science in the diagnostics of industrial devices**

Type of the course	Specialty lecture				
Course coordinator	Dr hab. inż. Krzysztof Rożniatowski, prof. PW	Course teacher	Dr inż. Łukasz Sarniak		
Implementing unit	Faculty of Materials Science and Engineering	Scientific discipline / disciplines*	Materials Engineering, Mechanical Engineering		
Level of education	Doctoral studies	Semester	spring		
Language of the course	English				
Type of assessment	Pass for assessment - final project with presentation	Number of hours in a semester	15	ECTS credits	1
Minimum number of participants	12	Maximum number of participants		Available for students (BSc, MSc)	Yes/~~No~~

Type of classes		Lecture	Auditory classes	Project classes	Laboratory	Seminar
Number of hours	in a week	2	-	-	-	-
	in a semester	15	-	-	-	-

* does not apply to the Researcher's Workshop

1. Prerequisites

None

2. Course objectives

The goal of the education is to obtain by PhD students the ability to use their knowledge in the field of material engineering to analyze the technical condition of industrial equipment and facilities, in the context of extending their life and reducing the risk of failures related to material degradation. It is connected, among others, with the ability to select the appropriate testing methodology and analysis of the results of the conducted research, and to formulate appropriate conclusions and recommendations for owners of industrial installations. The aim of education is also to familiarize students with the possibilities of available research methods (destructive and non-destructive), taking into account modern and advanced methods, current research trends and standards.

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

Lecture

The aim of education in this subject is to obtain by Ph.D. students the ability to use their knowledge in material science and engineering, analyze the technical condition of industrial equipment and facilities in the context of extending their life, and reducing the risk of failures related to material degradation. In this context, students will acquire the ability to select the appropriate testing methodology, analyze the results and formulate appropriate conclusions and recommendations for owners of industrial installations. The training aims to familiarize students with the possibilities of available testing methods (both destructive and non-destructive), including modern and advanced methods, taking into account current standards and testing trends.

During the course, doctoral students will also learn the possibilities of the available destructive and non-destructive testing methods in technical diagnostics and current trends in their application and the concept of RBI processes and operational control programs.

Students will have the opportunity to verify and consolidate the knowledge obtained during the course during the final project preparation. The task of the project will be to develop guidelines for the research methodology of the selected industrial facility/installation, taking into account its operating parameters, appropriate acceptance criteria, and current standards. Presentations will be prepared in small subgroups, and their results will be jointly presented and discussed at the end of course.

W1. Lecture 1. Introduction to technical diagnostics and introduction and basics of non-destructive testing methods (2 h) **W2**. Lecture 2. Selection of research methodology and operational control programs and RBI (2 h) **W3**. Lecture 3. Non-destructive testing - surface methods and non-destructive testing - volumetric methods: part I (2h) **W4**. Lecture 4. Non-destructive testing - volumetric methods: part II (2 h) **W5**. Lecture 5. Destructive testing in industrial practice and modern research methods. Analysis of the results of non-destructive testing (2 h) **W6**. Lecture 6. Acceptance criteria and normative documents (2 h) **W7**. Project presentation and discussion (2 h) **W8.** Project presentation and discussion (1 h)
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	Knowledge of the basics and objectives of technical diagnostics;	SD_W1, SD_W2, SD_W3	project evaluation
K02	Knowledge of the possibilities of available methods of destructive and non-destructive testing and current trends in their application;	SD_W1, SD_W2, SD_W3	project evaluation
K03	Knowledge of RBI process concepts and operational control programs;	SD_W1, SD_W2, SD_W3	project evaluation
Skills			
S01	Ability to use knowledge in the field of materials engineering to analyze the technical condition of equipment and industrial facilities;	SD_U1, SD_U2, SD_U3, SD_U4	project evaluation
S02	Ability to select a research methodology depending on the diagnosed industrial object;	SD_U1, SD_U2, SD_U3, SD_U4	project evaluation
S03	Ability to analyze the results of industrial research and formulate relevant conclusions and recommendations;	SD_U1, SD_U2, SD_U3, SD_U4	project evaluation
S04	Ability to select appropriate acceptance criteria based on current normative documents;	SD_U1, SD_U2, SD_U3, SD_U4	project evaluation
S05	Improving teamwork skills;	SD_U7	project evaluation
Social competences			

SC01	Presentation of own concepts, analyses and guidelines and the ability to conduct an informed discussion in this area.	SD_K2	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
Final project with a presentation - development of guidelines for the testing methodology of a selected industrial facility / installation, taking into account its operating parameters, appropriate acceptance criteria and current standards.

6. Literature
Primary references:
[1] API 510 Pressure Vessel Inspection Code: Maintenance Inspection, Rating, Repair, and Alteration
[2] ASME Boiler and Pressure Vessel Code V: Nondestructive Examination
[3] PED 2014/68/EU: Pressure Equipment Directive
[4] ISO/IEC 17025 Standard: General requirements for the competence of testing and calibration laboratories
[5] EN ISO 9712 Standard: Non-destructive testing — Qualification and certification of NDT personnel
Secondary references:
[1] Normative documents concerning the application of particular testing methods

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	15
2	Hours of consultations with the academic teacher, exams, tests, etc.	2
3	Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework	5
4	Amount of time devoted to the preparation for exams, test, assessments	5
	Total number of hours	**27**
	ECTS credits	**1**

** 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	1
Number of ECTS credits earned by a student in a practical course	0