

Cracow University of Technology

## Course syllabus

binding for the doctoral students of the CUT Doctoral School commencing their studies  
in the academic year 2022/2023

### Information on the course

Name of the course in Polish	Eksperymentalne metody detekcji zniszczenia konstrukcji
Name of the course in English	Experimental methods of failure detection of structures
Number of the ECTS points	1
Language of instruction	Polish
Category of the course	Choosable
Field of education	Engineering and technology
Discipline of education	Mechanical engineering
Person responsible for the course Contact	Marek Barski, <i>doctor habilitatus</i> , prof. of CUT marek.barski@pk.edu.pl

### Type of course, number of hours in the study programme curriculum

Semester	Credit type (G / NG)*	Lecture	Practical classes	Laboratory	Computer Lab	Project Class	Seminar
2, 3, 4, 5	G	15	0	0	0	0	0

\*G – graded credit, NG – non-graded credit

### Course objectives

Code	Objective description
Objective 1	Discussion of the construction and applications of modern composite materials as well as the mechanisms of the formation of damage ultimately leading to the destruction of composite structures.
Objective 2	Presentation of the idea of Non-Destructive Testing (NDT), Structural Health Monitoring (SHM).
Objective 3	Overview of selected NDT and SHM methods: active and passive thermography, digital image correlation, propagation of elastic waves.

### Learning outcomes

Code	Description of the learning outcome adjusted to the specific characteristics of the discipline	Learning outcome symbol in the CUD DS	Methods of verification
<b>OUTCOMES RELATED TO KNOWLEDGE</b>			
EUW1	The doctoral student has a basic knowledge of the construction of composite materials.	E_W01, E_W02	Involvement in class activities, discussion.

EUW2	The doctoral student has a basic knowledge of the failure mechanisms in structures made of both traditional materials (metal alloys) and composite materials.	E_W01,	Involvement in class activities, discussion.
<b>OUTCOMES RELATED TO SKILLS</b>			
EUU1	The doctoral student is able to identify the basic advantages and disadvantages of composite materials and the influence of the internal structure of composites on the process of damage caused by static and cyclic (fatigue) loads.	E_U01	Discussion.
EUU2	The doctoral student is able to identify the basic characteristics of the methods of damage detection based on the use of active thermography, digital image correlation and the phenomenon of elastic wave propagation.	E_U01	Discussion.
<b>OUTCOMES RELATED TO SOCIAL COMPETENCES</b>			
EUK1	The doctoral student is able to indicate the potential economic benefits and the impact on the operational safety of various engineering structures resulting from the use of modern methods of damage detection in everyday life.	E_K01, E_K03	Discussion.

### Course outline

No.	Contents	Learning outcomes for the course	No. of hours
<b>LECTURE</b>			
W1	<ul style="list-style-type: none"> <li>• Examples of composite materials applications.</li> <li>• Structure of composite materials – basic concepts and definitions.</li> <li>• Constitutive equations for anisotropic materials.</li> <li>• Equations of motion and static equilibrium.</li> <li>• Failure criteria.</li> </ul>	EUW1, EUW2	3
W2	<ul style="list-style-type: none"> <li>• The concept of non-destructive testing.</li> <li>• Elastic waves, modes of elastic waves, curves of dispersion.</li> <li>• Methods for activating and detecting elastic waves.</li> <li>• Fault detection and location.</li> </ul>	EUU1, EUU2, EUK1	4
W3	<ul style="list-style-type: none"> <li>• Basic phenomena and concepts related to heat conduction and transport in various materials.</li> <li>• Active thermography.</li> <li>• Passive thermography.</li> </ul>	EUU1, EUU2, EUK1	4
W4	<ul style="list-style-type: none"> <li>• Construction of digital cameras and camcorders, types of lenses, types of sensors enabling image recording.</li> <li>• Digital image correlation.</li> <li>• Methodology for measuring structure displacement.</li> <li>• Digital cameras calibration.</li> <li>• Image correlation.</li> </ul>	EUU1, EUU2, EUK1	4

### The ECTS points statement

WORKING HOURS SETTLEMENT	
Type of activity	Average number of hours (45 min.) dedicated to the completion of an activity type
SCHEDULED CONTACT HOURS WITH AN ACADEMIC TEACHER	
Hours allotted in the syllabus	15
Consultations	1
Examination / course credit assignment	2
HOURS WITHOUT THE PARTICIPATION OF AN ACADEMIC TEACHER	
Independent study of the course contents	8
Preparation of a paper, a report, a project, a presentation, a discussion	4
ECTS POINTS STATEMENT	
Total number of hours	30
The ECTS points number	1

### Preliminary requirements

Lp.	Wymagania
1	General mechanics, strength of materials.
2	Knowledge of the English language.

### Course credit assignment conditions / method of the final grade calculation

No.	Description
COURSE CREDIT ASSIGNMENT CONDITIONS	
1	At least 80% attendance in class.
2	A presentation, discussion.
METHOD OF THE FINAL GRADE CALCULATION	
Average grade for the presentation and substantive discussion.	

### Additional information

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### The course reading list

1	Muc A., Mechanika kompozytów włóknistych, Kraków, 2003, Księgarnia Akademicka.
2	Giurgiutiu V., Structural Health Monitoring with Piezoelectric Wafer Active Sensors, 2008, Elsevier.
3	Oliferuk W., Termografia podczerwieni w nieniszczących badaniach materiałów i urządzeń, 2008, Biuro Gamma.
4	Sutton M. A., Ortu J. - J., Schreier H. W., Image correlation for Shape, Motion and Deformation, Basic Concepts, Theory and Applications, 2009, Springer.