COURSE DESCRIPTION CARD - SYLLABUS

Course name
Selected imaging techniques in bioengineering [S2IBio1-UMiR>WTOwB]

Course

Field of study
Biomedical Engineering

Year/Semester
2/3

Area of study (specialization)
Medical and Rehabilitation Devices

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
5

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Knowledge of basics of metrology and optics as well as mathematical analysis and statistics, technical drawing, machine parts and non-destructive testing. Willingness to acquire new knowledge and skills. The ability to think logically and use information obtained from various sources.

Course objective

Acquainting with non-destructive methods in metrology in bioengineering.

Course-related learning outcomes

Knowledge:
1. The student should characterize methods of non-destructive testing in metrology [K_W13]
2. The student should characterize the basic devices used in non-destructive testing [K_W13]

Skills:
1. The student is able to select the device for the measuring task [K_U17]
2. The student is able to develop a basic measurement strategy [K_U17]
3. The student is able to develop and analyze obtained results [K_U17]

Social competences:
1. The student is able to work in a group [K_K03]
2. The student is aware of the role of non-destructive testing in bioengineery [K_K02]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lecture: written or oral test
Laboratory: crediting on the base of an oral or written answer concerning the content of each performed laboratory exercise and preparation of reports. In order to pass the classes, all exercises must be completed.
In order to receive a pass mark, you must obtain at least 50% of the points possible in each subject area separately. The final mark is the average of the partial marks covering each subject area.

Programme content

Lecture:
1. Definition, structure and tasks of non-destructive testing in metrology.
2. Measuring devices used for non-destructive testing.
3. Passive thermography.
4. Active thermography.
5. Sources of excitations in active thermography.
6. Tests of the thickness of coatings.
7. X-ray micro computed tomography.
8. Possibilities of product evaluation on the basis of computed tomography.
9. Optical interferometry and holographic microscopy to investigate physical properties of subtransparent biomedical materials.
10. Vibrometry and shearography to assess local deformations and stresses of materials.
Laboratory:
1. Measurements using a thermographic camera.
2. Measurements with the use of an active thermal imaging system.
3. Measurements with the use of computed tomography - basics.
4. Detection of defects and non-destructive testing with the use of computed tomography.
5. Measurements using optical interferometric methods and holographic microscopy.
6. Detection by non-contact methods: holographic vibrometry and shearography local deformations, stresses and internal defects.

Course topics

Lecture:
Product defects: definitions, classifications, general division.
Classification of manufacturing defects resulting from the use of various manufacturing techniques: defects of products after heat treatment, defects of castings, defects of bonded joints, defects of plastic products and those made with additive techniques.
Operating defects: mechanical, thermal, complex (corrosive-mechanical, thermal-mechanical).
Non-destructive testing: reasons for conducting research, possibilities, application, criteria for object evaluation.
The method using electromagnetic radiation - X-ray examinations and computed tomography - purpose, scope, principle of research.
A method that uses passive and active infrared thermography - purpose, scope, principle of research (eddy current method, mechanical extortion method, optical extortion method).
Comprehensive testing equipment.

Lab:

1. Development of a methodology for measuring individual critical features.
2. The use of modern measurement systems for the identification of object defects.

Teaching methods

Lecture: multimedia presentation illustrated with examples given on the whiteboard and films.
Laboratory exercises: performing experiments, case study, discussion, working in a group.

Bibliography

Basic
B. Więcek, G de Mey: „Termowizja w podczerwieni. Podstawy i zastosowania”, Wydawnictwo PAK, Warszawa, 2011.
W. Minkina: „Pomiary termowizyjne – przyrządy i metody”, Wydawnictwo Politechniki Częstochowskiej, Częstochowa 2004.
E. Ratajczyk, A. Woźniak: „Współrzędnościowe systemy pomiarowe”, Wydawnictwo Politechniki Warszawskiej, Warszawa 2016.
K. Patorski, M.Kujawińska, L.Sałbut: „Interferometria laserowa z automatyczną analizą obrazu”, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005.
E. Hecht, "Optyka" Wydawnictwo Naukowe PWN, Warszawa 2012.
Additional
O. Breitenstein, M. Langenkamp: „Lock-in Thermography”, Springer-Verlag Berlin, Heildelberg 2003
X. Maldague: “Theory and Practice of Infrared Technology for Nondestructive Testing”. John Wiley & Sons Inc.,New York 2001.
R. Christopg, H.J. Neumann: “X-ray Tomography in Industrial Metrology, Precise, Economical and Universal”, Verlag Moderne Industrie 2011, ISBN 978-3-86236-020-8.
B. Ziętek: “Optoelektronika”, Wydawnictwo Uniwersytetu Mikołaja Kopernika, Toruń 2005.
P. Hariharan: “Optical Holography; Principles, Techniques and Applications”, Cambridge University Press, 2nd edition, Cambridge 2008.
B. Gapiński: "Obrazowanie i pomiary w technicznej tomografii komputerowej ze szcze-gólnym uwzględnieniem przedmiotów wykonanych technikami przyrostowymi i analizy nierówności powierzchni". Wydawnictwo Studio Poligrafia, ISBN 978-83-953889-0-3, 2019.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00