COURSE DESCRIPTION CARD - SYLLABUS

Course name
Non-destructive investigation methods [S2ETI2>MBN]

Course

Field of study
Education in Technology and Informatics

Year/Semester
1/2

Area of study (specialization)
–

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
30

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of physics acquired during first cycle studies. The ability to solve basic problems in physics based on the acquired knowledge, the ability to obtain information from the indicated sources. The student understands the necessity of expanding his competences, willingness to cooperate within the team.

Course objective

The aim of the course is to familiarize students with non-destructive testing (NDT) methods and measuring equipment used in industry, science and medicine.

Course-related learning outcomes

Knowledge:
1. Can explain the structure and operation principles of fundamental research and measurement instruments - K2_W03.
2. Knows and understands main development trends and major achievements in technologies relevant to the field of Education in Technology and Informatics

Skills:

1. Can acquire information from literature, databases, and other sources, integrate them and critically evaluate it
2. Can select and apply appropriate methods, tools, and scientific studies related to technical problems
3. Demonstrates the ability to plan and carry out lifelong learning processes independently and identify directions for further professional development

Social competences:
1. Is ready to critically assess own knowledge and received information in the field of technology and materials engineering and understands the necessity of lifelong learning
2. Is prepared to assume the social role of a technical university graduate, to inspire and organize activities for the social environment, and to communicate information and opinions concerning technological achievements and other aspects of engineering practice

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The learning outcomes listed above are verified through a 90-minute written exam (conducted during the examination session) consisting of approximately eight open-ended questions with variable scoring. Exam topics and supporting materials used for question development are made available on the eKursy platform.
Assessment criteria/assessment: in accordance with the study regulations

Programme content

The lecture covers various non-destructive testing methods, including:
- ultrasonography
- thermography
- radiography (X-ray)
- electron microscopy
- Scanning Probe Microscopy (SPM)
- Nuclear Magnetic Resonance (NMR)
- Electron Paramagnetic Resonance (EPR)
- Raman and Infrared Absorption Spectroscopy

Discussion includes physical principles underlying these techniques, design and operation of selected NDT instruments, and extensive examples of industrial, scientific, and medical applications.

Course topics

- ultrasonography: classification of acoustic waves, attenuation factors, generation of ultrasonic waves, instrumentation and applications in science, technology, and medicine.
- thermography: fundamentals of thermal radiation, construction and operation of pyrometers and thermal imaging cameras, examples of applications.
- radiography: X-ray generation, X-ray spectra, X-ray tube, CT scanner design, and examples of applications in science, technology, and medicine.
- electron microscopy: de Broglie waves, construction and use of TEM and SEM microscopes.
- Scanning Probe Microscopy: construction and principle of AFM and STM microscopes, applications.
- Nuclear Magnetic Resonance: physical principles of NMR, spectrometer design and operation, magnetic resonance imaging (MRI), and other NMR applications.
- Electron Paramagnetic Resonance: electron paramagnetism, microwaves, klystron, basic principles of EPR, applications.
- Raman and Infrared Absorption Spectroscopy: Raman effect, infrared absorption, vibrational spectroscopy, selection rules, applications.

Teaching methods

Lecture: multimedia presentation illustrated with graphic examples, animations and films.

Bibliography

Basic:
1. Andrzej Oleś, „Metody doświadczalne fizyki ciała stałego”, WNT, Warszawa 1998.

2. Zbigniew Kęcki, „Podstawy spektroskopii molekularnej”, Wydawnictwo Naukowe PWN, Warszawa 1992.
3. Antoni Śliwiński, „Ultradźwięki i ich zastosowania” Wydawnictwa Naukowo-Techniczne, Warszawa 2001.
4. Mirosław Drozdowski, „Spektroskopia ciała stałego”, Wydawnictwo Politechniki Poznańskiej, Poznań 1996.
5. Zygmunt Trzaska Durski, Hanna Trzaska Durska, „Podstawy krystalografii strukturalnej i rentgenowskiej”, Wydawnictwo Naukowe PWN, Warszawa 1994.

Additional:
1. Charles Kittel, „Wstęp do fizyki ciała stałego”, Wydawnictwo Naukowe PWN, Warszawa 2012.
2. George Turell, Jacques Corset, „Raman microscopy - Developments and Applications”, Elsevier Academic Press, London 2012.

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