COURSE DESCRIPTION CARD - SYLLABUS

Course name
Building Measuring Equipment [S2FT2>BAP]

Course

Field of study
Technical Physics

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
15

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Knowledge of physics, mathematics, electronics, mechanics, optics and vacuum technology at the Technical Physics undergraduate course level. Basic knowledge of engineering graphics. Skill in physical problem solving, skill in acquiring information from listed sources, ability to make engineering drawing. Skill in using of CAD programs. Understanding the necessity of personal competence development.

Course objective

1. Acquaintance of the students with problems concerning construction of scientific instruments illustrated by exemplary systems from selected fields of physics. 2. Development of skills in knowledge of physics application to solving problems connected to construction an configuration of scientific instruments systems. 3. Development of self-reliance in knowledge acquirement.

Course-related learning outcomes

Knowledge:
Student, who has completed the course
1. Is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments operation

2. Is able to explain construction and operation of selected measurement systems comprising technical solution of diverse branches of engineering - optics, electronics and mechanics
3. Is able to describe the process of constructing complex research systems, including technology implementation process comprising intellectual property resources management and to define selected elements of project preparation process

Skills:
Student, who has completed the course
1. Is able to use possessed knowledge to characterize quantitatively parameters of measuring instruments and to model their operation
2. Is able to extract information on technologies useful in scientific instruments construction from the literature, databases and other sources
3. Is able to prepare design documentation and specification sheet of selected research instruments and systems
4. Is able to define application areas of scientific and test instruments, considering importance for the streamlining of production process and products quality improvement

Social competences:
Student, who has completed the course
1. Understands the need of continuous self-improvement raising his or her professional competences because of fast development of technology applied to measuring apparatus
2. Understands the need of informing the society about new developments of scientific and test apparatus, because of potential applications in the fields important from the public interest point of view, like environmental protection and health care

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

In terms of the methods used to verify the achieved learning outcomes, the following grading thresholds are applied:
0-49,9% 2,0;
50-59,9% 3,0;
60-69,9% 3,5;
70-79,9% 4,0;
80-89,9% 4,5;
90-100% 5,0.
The grade is based on an individual written assignment and/or the assessment of an oral response.

Programme content

1. Basic signal parameters
2. Basics of analog and digital signal processing
3. Techniques of noise and interference reduction
4. Electronic measuring instruments
5. Advanced techniques of optical spectroscopy
6. Radiofrequency spectroscopy apparatus
7. Mass spectrometers and photoemission spectrometers
8. Scientific apparatus combining multiple measuring techniques

Course topics

1. Parameters of signals in measuring systems. Selected analogue circuits for signal processing. Basics of digital signal processing.
2. Noise and interference in measuring systems. Techniques of noise and interference reduction.
3. Electronic measuring instruments - construction, parameters and applications.
4. Advanced techniques of optical spectroscopy - review of scientific instruments construction. Atomic absorption spectroscopy, Fourier transform spectroscopy, absorption and emission laser spectroscopy, optical-microwave double resonance.
5. Apparatus for time-domain spectroscopy.
6. Radiofrequency spectroscopy apparatus - review. Components and systems utilized in construction of

radiofrequency spectrometers. Generation of magnetic field. Masers.
7. Mass spectrometers - construction and operation.
8. Photoemission spectroscopy
9. Scientific apparatus combining multiple measuring techniques.

Teaching methods

Lecture: multimedia presentation during lecture and electronic documents containing presentation content in a condensed form made available to the students via eKursy service.
Project classes: selected technical problem solving in the form of a individal tutorial and short multimedia presentations. Students work on their own on project documentation.

Bibliography

Basic:
1. Building Scientific Apparatus, J.H. Moore, Ch.C. Davis, M.A. Coplan, Cambridge University Press 2009
2. Laser Spectroscopy, W.Demtröder, Vol. 1 i 2, Springer Berlin Heidelberg 2008
3. Instrumenty optyczne, F. Ratajczyk, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2002
4. Elektronika w laboratorium naukowym, T. Stacewicz, A. Kotlicki, Wydawnictwo Naukowe PWN, Warszawa 1994
5. Wstęp do spektroskopii rezonansów magnetycznych, J. Stankowski, W. Hilczer, Wydawnictwo Naukowe PWN, Warszawa 2005
6. Technika pomiarowa, S. Tumański, Wydawnictwo Naukowe PWN, Warszawa 2016
7. Metody spektroskopowe w chemii analitycznej, Andrzej Cygański, Wydawnictwo WNT 2009

Additional:
1. Mikrofale. Układy i systemy, J. Szóstka, Wydawnictwa Komunikacji i Łączności, Warszawa 2006
2. Instrumentation Reference Book (4th Edition), Walt Boyes (ed), Butterworth-Heinemann 2010

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00