STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Structure of measuring equipment	**1010402211010421145**

Field of study	Profile of study (general academic, practical)	Year /Semester
TECHNICAL PHYSICS	**general academic**	**1 / 1**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
Second-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **2** Classes: **-** Laboratory: **-** Project/seminars: **1**	**2**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
other	**university-wide**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**2 100%**
Technical sciences	**2 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

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

Assumptions and objectives of the course:

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.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Student, who has completed the course, is able to select proper mathematical model for describing physical effects related to basis of selected scientific instruments operation. - [K_W01]
2. Student, who has completed the course, is able to explain construction and operation of selected measurement systems comprising technical solution of diverse branches of engineering ? optics, electronics and mechanics. - [K_W05]
3. Student, who has completed the course, 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. - [K_W06, K_W12, K_W13]

Skills:

1. Student, who has completed the course, is able to use mathematical knowledge to characterize quantitatively parameters of measuring instruments and to model their operation. - [K_U01]

2. Student, who has completed the course, is able to extract information on technologies useful in scientific instruments construction from the literature, databases and other sources. - [K_U02]

3. Student, who has completed the course, is able to prepare design documentation and specification sheet of selected research instruments and systems. - [K_U06, K_U10, K_U11, K_U16, K_U18]

4. Student, who has completed the course, is able to define application areas of scientific and test instruments, considering importance for the streamlining of production process and products quality improvement. - [K_U22]

Social competencies:

1. Student, who has completed the course, understands the need of continuous self-improvement raising his or her professional competences because of fast development of technology applied to measuring apparatus. - [K_K04]

2. Student, who has completed the course, 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. - [K_K08]

Assessment methods of study outcomes

W01, W02, W03, U04, K02

Assessment of knowledge and skills demonstrated in written work during the last lecture in semester on the grounds of scored points:

3,0 50.1%-70.0%

4,0 70.1%-90.0%

5,0 from 90.1%

U01, U02, U03, K01

Assessment on the grounds of written design documentation:

- assessment of construction assumptions, including correctness of mathematical model choice, the way of chosen model application and quality of results presentation,

- assessment of collected information concerning technologies, elements and sub-assemblies useful for the project completion,

- sources of information search invention assessment,

- assessment of project documentation from the point of view of information completeness, technical solutions presentation quality and design documentation correctness.

Course description

1. Fundamentals of signal theory - signal parameters. Basics of digital signal processing.

2. Noise and interference in measuring signal processing 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, Raman laser spectroscopy, optical-microwave double resonance.

5. Apparatus for time-domain laser 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. Scientific apparatus combining multiple measuring techniques.

Basic bibliography:

1. Building Scientific Apparatus, J.H. Moore, Ch.C. Davis, M.A. Coplan, Cambridge University Press 2009

2. Spektroskopia laserowa, W. Demtroeder, Wydawnictwo Naukowe PWN, Warszawa 1993

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. Sztuka elektroniki, P. Horowitz, W. Hill, Wydawnictwa Komunikacji i Łączności, Warszawa 2001

6. Wstęp do spektroskopii rezonansów magnetycznych, J. Stankowski, W. Hilczer, Wydawnictwo Naukowe PWN, Warszawa 2005

7. Mikrofale. Układy i systemy, J. Szóstka, Wydawnictwa Komunikacji i Łączności, Warszawa 2006

Additional bibliography:

1. Practical Optics, N. Menn, Elsevier Academic Press, Boston 2004

2. Fizyka doświadczalna, T. 1 - 6, S. Szczeniowski, Państwowe Wydawnictwo Naukowe 1983

Result of average student's workload	
Activity	**Time (working hours)**
1. Participation in lectures	30
2. Participation in consultations about a project	3
3. Making of a project	20
4. Preparation for an exam	12

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	65	2
Contact hours	33	1
Practical activities	23	1