Zał. nr 5 do ZW 78/2023

Attachment no. 4. to the Program of Studies

FACULTY of Chemistry

SUBJECT CARD

Name of subject in Polish Optyka nieliniowa dla Chemików
Name of subject in English Nonlinear Optics for Chemists
Main field of study (if applicable): Advanced Nano and Biomaterials - MONABIPHOT
Specialization (if applicable):
Profile: academic
Level and form of studies: 2nd level, full-time
Kind of subject: laboratory-obligatory / lecture-optional
Subject code W03ANB-SM21010W, W03ANB-SM2009L
Group of courses NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30		15		
Number of hours of total student workload (CNPS)	50		50		
Form of crediting (Examination / crediting with grade)	Crediting with grade		Crediting with grade		
For group of courses mark (X) final course					
Number of ECTS points	2		2		
including number of ECTS points for practical classes (P)			2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,3		0,7		

*delete as not necessary

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General physics,
2. General Chemistry

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SUBJECT OBJECTIVES

C1 To provide students with general knowledge about the fundamentals of the theory of nonlinear light interaction with matter.
C2 To provide students with knowledge about main nonlinear optical phenomena.
C3 To provide students with knowledge about the main methods of study of matter using laser beams of short pulses and strong power.
C4 To inform students about the application of nonlinear optics achievements in science and technology.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:

PEU_W01 – Student has systematized knowledge within the physical basis of optical field interaction with matter.

PEU_W02 - Students can understand the physics of nonlinear light interaction with matter at the microscopic and macroscopic levels

PEU_W03 - Student knows and recognizes nonlinear optical phenomena of second and third-order

PEU_W04 - Student knows and understands measurement methods used to evaluate nonlinear optical properties of optical materials

relating to skills:

PEU_U01 – Student has the ability to propose optical material for fulfilling desired functionality of second and third nonlinear optical type.

PEU_U02 – Student has the ability to design measurement setup to measure fundamental nonlinear optical properties of a material

PEU_U03 Student is able to perform chosen experiments in the field of nonlinear optics

relating to social competences:

PEU_K01 – The student is able to do research and overview of scientific literature

PEU_K02 – The student has a knowledge of the importance and role of light in contemporary life and of materials interacting with light in a nonlinear fashion for the production of economical and useful devices for mankind

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	Introduction to optics – light.	2
Lec 2	Basics of the light-matter interactions.	2
Lec 3	Harmonic oscillator approximation – linear effects.	2
Lec 4	Nonlinear optical medium, polarization, nonlinear optical susceptibilities.	2
Lec 5	Units, notation and conservation rules in nonlinear optics.	2
Lec 6	Phenomenological description of nonlinear optics phenomena. The most important second-order phenomena.	2
Lec 7	Phenomenological description of nonlinear optics phenomena. The most important third-order phenomena.	2
Lec 8	Detailed description of the second harmonic generation phenomenon.	2
Lec 9	Generation of sum and difference frequencies. Wave mixing processes.	2
Lec 10	Nonlinear refractive index, Kerr media	2
Lec 11	Generation of supercontinuum, solitons, and ultra-short pulses.	2
Lec 12	Nonlinear light absorption and emission – selection rules in nonlinear optics.	2
Lec 13	Modern materials for nonlinear optics.	2
Lec 14	Evaluation test of students' knowledge.	2

Lec 15	Second evaluation test of students' knowledge.	2
	Total hours	30

Laboratory		**Number of hours**
Lab 1	Linear electrooptic effect – Pockels effect	3
Lab 2	Optical Kerr effect	3
Lab 3	Second harmonic generation	3
Lab 4	Degenerate two-wave mixing	3
Lab 5	Optical phase conjugation	3
	Total hours	15

TEACHING TOOLS USED

N1. Lecture with use of multimedia presentation.
N2. Laboratory of nonlinear optics – group work

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
P1 (lecture)	PEU_W01 PEU_W02 PEU_W03 PEU_W04 PEU_W05	Written test. Evaluation of test max. 100 pts 3.0 if 50-60 % pts 3.5 if 61-70 % pts 4.0 if 71-80 % pts 4.5 if 81-90% pts 5.0 if 91-95% pts 5.5 if 96-100 % pts
P1 (laboratory)	PEU_U01-PEU_U03, PEU-K01_PEU-K02	Evaluation of a single report of performed measurements

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] B.E. A. Saleh, M. C. Teich, Fundamentals of Photonics, Wiley, New York, 1999
[2] P. N. Prasad, Nanophotonics, Wiley-Interscience, New Jersey, 2004
[3] Pavel Chmela,"Wprowadzenie do optyki nieliniowej", PWN, Warszawa 1987
[4] A. Yariv, P.Yeh," Optical waves in crystals", Wiley 1984
[5] F. Kaczmarek, „Wstęp do fizyki laserów", PWN, Warszawa 1986
[6] S. Kielich, "Molekularna optyka nieliniowa", PWN Warszawa, 1977

SECONDARY LITERATURE:

[1] Photonics journal
[2] Original scientific articles available through the electronic literature database of the Main Library of WUST

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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