FACULTY OF CHEMISTRY

SUBJECT CARD

Name of subject in English:	NONLINEAR OPTICS FOR CHEMISTS
Main field of study (if applicable):	Chemistry and Engineering of Materials
Specialization (if applicable):	Advanced Nano and Bio-materials – MONABIPHOT
Profile:	academic
Level and form of studies:	2nd level, full-time
Kind of subject:	optional, obligatory*
Subject code:	IMC024020
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)	60		60		
Form of crediting	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 (P) classes					
including number of ECTS points for direct teacher-student contact (BK) classes	1		0,5		

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. General physics
2. General chemistry

SUBJECT OBJECTIVES

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

SUBJECT EDUCATIONAL EFFECTS

related to knowledge:

PEK_W01 – Student has systematized knowledge within the physical basis of optical field interaction with matter.
PEK_W02 - Student can understands the physics of nonlinear light interaction with matter at the microscopic and macroscopic levels
PEK_W03 - Student knows and recognizes nonlinear optical phenomena of second and third order
PEK_W04 - Student knows and understands measurement methods used to evaluation of nonlinear optical properties of optical materials

related to skills:

PEK_U01 – Student has an ability to propose optical material for fulfilling desired functionality of second and third nonlinear optical type.
PEK_U02 – Student has an ability to design measurement setup to measure fundamental nonlinear optical properties of a material
PEK_U03 Student is able to perform chosen experiments in the field of nonlinear optics

Related to social competencies:

PEK_K01 – student is able to made a scientific search from literature and make an overview
PEK_K02 - student has a knowledge of importance and role of light in contemporary life and of materials interacting with light in nonlinear fashion for production of economic and useful for mankind devices

PROGRAMME CONTENT

	Lectures	**Number of hours**
Lec 1	Introduction to optics of anisotropic materials	2
Lec 2	Use of pulsed laser in material science	2
Lec 3	Harmonic oscillator model for description of linear optical processes.	2
Lec 4	Nonlinear optical medium, polarisation and nonlinear optical susceptibilities.	2
Lec 5	Phenomenological description of nonlinear optical processes of second order.	2
Lec 6	Phenomenological description of nonlinear optical processes of third order.	
Lec 7	Parametric and nonparametric optical processes.	2
Lec 8	Second Harmonic Generation (SHG) and phase matching.	2
Lec 9	Wave-mixing processes: four-wave mixing	2
Lec 10	Self-action optical processes: self-focusing, auto collimation	2
Lec 11	Nonlinear refractive index, Kerr media.	2
Lec 12	Mechanisms related to third order nonlinear optical processes.	2
Lec 13	Main experimental methods used to study nonlinear optical effects.	2
Lec 14	Contemporary materials for nonlinear optics.	2
Lec 15	Summary. Evaluation of student's 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. Lecture with elements of discussion of problems.
N3. Laboratory of nonlinear optics – group work

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

Evaluation (F – forming (during semester), P – concluding (at semester end)	Educational effect number	Way of evaluating educational effect achievement
P1 (lecture)	PEK_W01-PEK_W05	Written test. Evaluation of test max. 100 pts 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)		Evaluation of 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 electronic literature database of Main Library of WUST

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

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