

## SYLLABUS 2016/2017

Level of study	Masters'course		
Course title in Ukraine	Нелінійна оптика		
Course title in English	Optical and nonlinear optical phenomena in semiconductors and dielectrics		
Course code		ECTS credits	3
Lecturer(s)	Prof. Vasilij Moiseyenko Email address: <a href="mailto:vnmois@yandex.ru">vnmois@yandex.ru</a>		

Course objectives (learning outcomes)	<p>This course aims at providing an introduction to nonlinear optics of dielectric crystals and optical systems and its applications in Physics and optical information processing.</p> <p>The students will be exposed to nonlinear-optical phenomenas in crystal and nonlinear optical resonator.</p> <p>The course also seeks to provide the background knowledge necessary to understand in reading of research articles.</p>
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### Prerequisites:

Knowledge	Knowledge's of nonlinear-optical phenomenas on the level of the highest school.
Skills	Physical skills at a rate of highest school.
Courses completed	No requirements.

### Learning effects:

	Learning effects of of the course	Relation of the learning effects to the specialization
Knowledge	<p><b>W01</b> A student has a basic knowledge about a nonlinear polarization of solids.</p> <p><b>W02</b> A student learns basics information about nonlinear optical phenomenas, conditioned interaction of the lazer radiation with material.</p> <p><b>W03</b> A student knows main phenomenas in nonlinear lazer resonator.</p> <p><b>W04</b> A student acquires knowledge about using phenomenas in nonlinear lazer resonator for information handling.</p>	W01 – W10

	Learning effects of the course	Relation of the learning effects to the specialization
Skills	<p><b>U01</b> A student can analyse nonlinear-optical phenomenas second and third order.</p> <p><b>U02</b> A student understands main regularities of the spreading femtosecond lazer pulse in solids and the methods of the duration measurement of ultrashort optical impulses.</p> <p><b>U03</b> A student understands main regularities of the nonlinear-optical phenomenas under the action of ultrashort optical impulses.</p> <p><b>U04</b> A student understands main regularities of nonlinear-optical phenomenas in lazer resonator.</p>	U01 – U07

	Learning effects of the course	Relation of the learning effects to the specialization
	<b>K01.</b> A student has the creativity and the ability to conceptual thinking. <b>K02</b> A student is able to present and justify the personal point of view. <b>K03</b> A student is able to use the information technologies for the communication with the scientific community. <b>K04</b> A student is aimed to expand personal knowledge and skills. <b>K05</b> A student has the legal erudition. <b>K06</b> A student concerned about the environmental safety of physical experiment.	K01 – K06

### Course organization:

Form of classes	Lecture (W)	Group-exercises						
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)	
Contact hours	26						1	
Semester	2							
Language	English, Ukrainian							

### Teaching methods:

Classes will be performed in tutorial system on a weekly basis using multimedia presentation and internet in a form of the lectures open for discussion and questions.  
 In-class exercises are designed to probe knowledge developed through this process, with emphasis on how well students have understood the underlying mathematical and physical ideas.  
 The students will prepare one individual presentation.

### Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	assignment (essay)	Oral exam	Written exam	Other
W01						x		x				x	
W02						x		x				x	
W03						x		x				x	
W04						x		x	x			x	
U01							x	x				x	
U02							x	x				x	
U03							x	x				x	
U04							x	x				x	

K01						x		x	x			x	
K02							x	x				x	
K03							x	x	x			x	
K04						x	x	x				x	
K05												x	
K06												x	

#### Assessment criteria:

Grades	<p>The grading scale will be as follows:</p> <p>90 – 100 % - <b>A</b> including <b>A- excellent</b> (eq. in Ukraine: відмінно (very good))</p> <p>82–89 % : <b>B</b> including <b>B – very good</b> (eq. in Ukraine: добре ( good))</p> <p>74–81 %: <b>C</b> including <b>C – good</b> (eq. in Ukraine: добре ( good))</p> <p>64–73 %: <b>D</b> including <b>D – satisfactory</b> (eq. in Ukraine: задовільно (satisfactory))</p> <p>60–63 %: <b>E</b> including <b>E – acceptable</b> (eq. in Ukraine: задовільно (satisfactory))</p> <p>&lt; 59 %: <b>F failed</b> (eq. in Ukraine: незадовільно (unsatisfactory))</p>
Criteria	<p><b>A.</b> A student knows all terms and concepts mentioned in W1-W4, U1- U4 and K1-K4. A student can work without any assistances, his/her knowledge's are creative and easily applied to decision of specific problem.</p> <p><b>B.</b> A student knows all terms and concepts mentioned in W1-W4, U1- U4 and K1-K4, yet needs a little help when decision of specific problem.</p> <p><b>C.</b> A student knows all terms and concepts mentioned in W1-W4, U1- U4 and K1-K4, however needs a help when decision of specific problem.</p> <p><b>D.</b> A student knows the most of terms and concepts mentioned in W1-W4, U1- U4 and K1-K4 and has difficulty in decision of specific problem.</p> <p><b>E.</b> A student knows only several terms and concepts mentioned in W1-W4, U1- U4 and K1-K4 and can solve only a simple problem.</p> <p><b>F.</b> A student does not know most of terms and concepts mentioned in W1-W4, he/she did not reach the satisfactory level of knowledge this course.</p>

#### Course content (topic list):

Topics	<p><b>W1.</b> The nonlinear polarization of solids. Second Harmonic Generation in Nonlinear Optical Crystal. Phase Matching</p> <p><b>W2.</b> Spontaneous parametric down-conversion. Basic process. Applications</p> <p><b>W3.</b> Optical bistability in a nonlinear Fabry-Perot interferometer with intensity-dependent refractive index. Applications</p> <p><b>W4.</b> Stimulated Raman scattering. Applications</p> <p><b>W5.</b> Kerr-induced self-focusing</p> <p><b>W6.</b> Self-phase modulation</p> <p><b>W7.</b> Generation of Femtosecond Laser Pulses. The Ti:sapphire Oscillator</p> <p><b>W8.</b> The standard techniques in determining the temporal profile of the pulse</p> <p><b>W9.</b> Second Harmonic Generation of Femtosecond Laser Pulses</p> <p><b>W10.</b> Stimulated Raman scattering</p> <p><b>W11.</b> Ultrafast-laser-induced stimulated Raman scattering</p> <p><b>W12.</b> Optical Solitons in a Nonlinear Fiber. Nonlinear Schrödinger equations</p> <p><b>W13.</b> The evolution of two spatially separated light beams in a nonlinear Kerr medium</p> <p><b>W14.</b> Nonlinear Optical systems. Principles and Phenomena</p> <p><b>W15.</b> Nonlinear polarization effects</p> <p><b>W16.</b> Optical Echo</p>
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**Literature:**

Compulsory reading	И.Р.Шен. Принципы нелинейной оптики. М.: «Наука», 1989. Ахманов С.А. и др. Оптика фемтосекундных лазерных импульсов. – М.: Наука, 1988. – 312 с. Новые физические принципы оптической обработки информации. Под ред. С.А.Ахманова и М.А.Воронцова. М.: Наука, 1990. 400 с.
Recommended reading	Г.Агравал. Нелинейная волоконная оптика. М.: «Мир», 1996.

**Estimation of the total working time of students:**

Contact hours	Lectures	26
	Seminars	
	Other (consultation, meetings)	14
Students' work hours (without the lecturer)	Reading books and preparation for the lectures	10
	Preparation for quizzes and exercises	5
	Preparation of an individual presentation	5
	Preparation to the exam	15
Total works' hours		75
ECTS credits 1 ECTS = 25 h		3