

## SYLLABUS 2017/2018

Level of study	Master's course		
Course title in Ukraine	Нелінійні властивості твердих тіл		
Course title in English	Nonlinear properties of solid state		
Course code		ECTS credits	4
Lecturer(s)	Dr.Sci., prof. Volnyanskii M.D. Email address: mdvoln@i.ua;		

Course objectives (learning outcomes)	<p>The purpose of discipline - the study of physical phenomena underlying foundations of modern uses dielectric crystals active in the development of laser radiation control devices, telecommunication systems, communication systems and systems for processing and storing information. Tasks of the course - learn the basic concepts underlying the theory of elasticity, electro- and magneto-optics, and be able to practically apply them. A study of discipline a student must have a solid theoretical knowledge and be able to use them in solving specific problems.</p> <p>The course also seeks to provide the background knowledge necessary to understand and reading of scientific and technical literature.</p>
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### Prerequisites:

Knowledge	The knowledge of elasticity, optic and solid state physics.
Skills	The skills use the physics conceptions for practical applications.
Courses completed	The bachelor of physics or applied physics.

### Learning effects:

	Learning effects of the course	Relation of the learning effects to the specialization
Knowledge	<p><b>W01</b> A student knows physical essence and theoretical models of electro-optical phenomena observed in materials in the condensed state.</p> <p><b>W02</b> A student knows physical essence and theoretical models of acoustic phenomena observed in materials in the condensed state.</p> <p><b>W03</b> A student knows the modern experimental methods of acoustooptics (Bragg diffraction, Raman-Nath diffraction, diffraction-Schaefer Bergman).</p> <p><b>W04</b> A student knows the basic principles of the devices in various fields of functional electronics (optical, akusto-, magnetic and others)</p>	W01 – W10

	Learning effects of the course	Relation of the learning effects to the specialization
Skills	<p><b>U01</b> A student can consider and describe on the proper level (using tensor analysis) electro-optical properties of new materials in the condensed state.</p> <p><b>U02</b> A student can consider and describe on the proper level (using tensor analysis) acousto-optical properties of new materials in the condensed state.</p> <p><b>U03</b> A student is able to make flowcharts and experimental facilities for research and electro-acoustic properties in the condensed state.</p> <p><b>U04</b> A student is able to count parameters and electro acoustic devices. calculate the parameters of optical fiber.</p> <p><b>U05</b> A student is able to understand and read the popular science and technical literature in field of information-measuring technology and optical communication.</p>	U01 – U07

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

### Course organization:

Form of classes	Lecture (W)	Group-exercises									
		A (large group)	K (small group)		L (Lab)		S (Seminar)		P (Project)		T. (Test)
Contact hours	12		14								1
Semester	1										
Language	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 with emphasis on how well students have understood the underlying topics of course.

The students will prepare two of individual presentation.

**Assessment methods:**

	E - learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Test
W01								x					x
W02								x	x				x
W03								x					x
W04								x	x				x
U01							x	x					x
U02							x	x					x
U03							x	x					x
U04							x	x					x
U05							x	x					x
K01								x	x				x
K02							x	x					x
K03							x	x	x				x
K04							x	x					x
K05							x	x					x
K06							x	x					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	<ol style="list-style-type: none"> <li>1. Linear electro-optical effect. The equation of the linear electro-optical effect.</li> <li>2. Electro-optical effect in <math>\text{KH}_2\text{PO}_4</math>. Electro-optical effect in <math>\text{LiNbO}_3</math>.</li> <li>3. The polarization of the monochromatic plane waves.</li> <li>4. Electro-optical modulation. Amplitude modulation. Phase modulation of light.</li> <li>5. Quadratic electro-optical effect. The equation of the quadratic electro-optical effect. Electro-optical Kerr effect in an isotropic medium. Electro-optical effect in <math>\text{BaTiO}_3</math>.</li> <li>6. Acousto-optical phenomena.</li> <li>7. Photoelastic effect. 8. Diffraction of light by elastic waves.</li> <li>9. Acousto-optic modulators.</li> <li>10. Acousto-optic deflectors.</li> <li>11. Acousto-optical filters.</li> </ol>
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**Literature:**

Compulsory reading	<ol style="list-style-type: none"> <li>1. Sonin A.S. Electro-optical crystals. Moscow "Atomizdat», 1971.</li> <li>2. Delesan E., Ruae D. Elastic waves in solids. Moscow "Mir", 1982.</li> <li>3. Mustel E.R, Parigin V.N. Modulation techniques and scanning light. Moscow "Science", 1970.</li> <li>4. Akayev A.A., Mayorov S.A. Optical methods of information processing. Moscow "High School", 1988.</li> <li>5. Yariv A., Yeh P. Optical waves in crystals. Moscow "Mir", 1978.</li> </ol>
Recommended reading	<ol style="list-style-type: none"> <li>1. Vaniryuhin A.I., Grechanovskaya V.P. Optical-Electrical Wheels polarization devices. Kiev "Technology", 1984.</li> <li>2. Magdich L.N., Molchanov V.Y. Acousto-optical devices and their applications. Moscow "Sov. Radio», 1978.</li> <li>3. Mushroom B.N. Electro-optical light deflectors. Kiev "Technology", 1980.</li> </ol>

**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	20
	Preparation for quizzes and exercises	
	Preparation of an individual presentation	20
	Preparation to the test	20
Total works' hours		100
ECTS credits 1 ECTS = 25 h		4