

## SYLLABUS 2019/2020

Level of study	Master's Course
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Course title in Ukraine	Актуальні проблеми фізики конденсованого стану Actual problems in condensed matter physics		
Course title in English	Actual problems in condensed matter physics		
Course code		ECTS credits	4
Lecturer(s)	Dr.Sci., prof. Trubitsin M.P. Email address: trubitsyn_m@ua.fm		

Course objectives (learning outcomes)	This course aims to provide an introduction to the basic ideas and major topics in nanomaterials and nanotechnology. The students will learn the main properties of dielectric and semiconductor nanostructured crystalline systems, electrical and optical phenomena in the systems with confined geometry, basic aspects of nanomaterials production and practical applications.
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### Prerequisites:

Knowledge	Knowledge of mathematics and physics on the level of bachelor in physics or applied physics
Skills	Mathematical and physical skills on the level of bachelor in physics or applied physics
Courses completed	The bachelor in physics or applied physics.

### Learning effects:

	Learning effects of the course	Relation of the learning effects to the specialization
Knowledge	<b>W01</b> A student has a basic knowledge in general and quantum mechanic physics. <b>W02</b> A student understands foundations of physics of nanostructured systems. <b>W03</b> A student comprehends physical principles of theoretical description of phenomena in nanoscale systems. <b>W04</b> A student knows the general trends and directions of scientific and technological progress in the field of nanotechnology.	W01 – W10
Skills	Learning effects of the course	Relation of the learning effects to the specialization

	<p><b>U01</b> A student is able to use mathematical tools of quantum mechanics to describe the physical phenomena in the nanostructured systems.</p> <p><b>U02</b> A student is able to use theoretical knowledge in solving specific problems, calculations of physical phenomena in nanosystems.</p> <p><b>U03</b> A student understands and can use logic and architecture of electronic nanocomputers.</p> <p><b>U04</b> A student can apply the basic principles of new technologies and techniques in the production of functional nanostructured materials.</p>	U01 – U07
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Social skills	Learning effects of the course	Relation of the learning effects to the specialization
	<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)	Exam		
Contact hours	24		14				1		
Semester	1								
Language	English, Ukrainian, Russian								

### 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	written assignment (essay)	Oral exam	Written exam	Test
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	<ul style="list-style-type: none"> <li>1. The era of nanotechnology.</li> <li>W1. Nanocrystal Structures.</li> <li>W2. Basic physical prerequisites of nanotechnology.</li> <li>2. Features of nanophysics.</li> <li>W3. Potential wells, barriers and tunneling.</li> <li>W4. Superlattices.</li> <li>3. Methods of nanotechnology.</li> <li>W5. Traditional methods.</li> <li>W6. UV, X-ray, electron lithography.</li> <li>W7. New technologies (mehanosynteZ, chemical synthesis).</li> <li>4. Nanoelectronic devices.</li> <li>W8. Materials for nanoelectronic devices.</li> <li>W9. Diamond, graphite, fullerenes, nanotubes.</li> <li>W10. Devices for nanoelectronic circuits (tunnel-resonant diode single-electron diode cell quantum dots).</li> <li>5. Logic and architecture of electronic nanocomputer.</li> <li>W11. Calculations using a wireless base status.</li> <li>W12. Nets of quantum cells.</li> </ul>
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**Literature:**

Compulsory reading	1. А. И. Гусев, А.А.Ремпель. Нанокристаллические материалы . - М Физматлит, 2000. - 224 с. 2. А. И. Гусев. Наноматериалы, наноструктуры, нанотехнологии. - М Физматлит, 2005. - 416 с. 3. И.П. Суздаев. Нанотехнология: физико- химия нанокластеров, наноструктур и наноматериалов.- М.: КомКнига, 2006.- 592 с. 4. Ю.М. Поплавко, О.В. Борисов, В.І. Ильченко, Ю.І. Якименко Мікроелектроніка і наноелектроніка, Київ, НТУУ «КПІ», 2010. 5. Глинчук М.Д., Рагуля А.Н. Наноферроики. Киев: Наукова думка, 2010.
Recommended reading	6. А.А. Щука. Наноэлектроника. - М.: Физматгиз, 2007. - 462 с. 7. Г. П. Берман и др. Введение в квантовые компьютеры М. – Ижевск, 2004, 188 с.

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

Contact hours	Lectures	38
	Seminars	
	Other (consultation, meetings)	6
Students' work hours (without the lecturer)	Reading books and preparation for the lectures	20
	Preparation to the seminar	
	Preparation of an individual presentation	16
	Preparation to the test	20
Total works' hours		100
ECTS credits 1 ECTS = 25 h		4