

## SYLLABUS 2019/2020

Level of study	Master's Course		
Course title in Ukraine	Наноматеріали та нанотехнології		
Course title in English	<i>Nanomaterials and nanotechnology</i>		
Course code		ECTS credits	5
Lecturer(s)	Dr.Sci., prof. Klymenko Victor Vasyl'ovych Email address: klimenkonn@yandex.ru;		

Course objectives (learning outcomes)	<p>This course aims at assimilation of physical principles of the functioning and potentialities of practical application of nanomaterials.</p> <p>The students will study the design features of some nanomaterials and the principles of their production.</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	Knowledge of mathematics and physics on the level of bachelor in physics or applied physics, knowledge of physical optics, solid state physics and semiconductor 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	<p><b>W01</b> A student knows the structure and physical properties of quantum nanostructures.</p> <p><b>W02</b> A student knows the base methods preparation of quantum nanostructures</p> <p><b>W03</b> A student knows the physical effects used to measure various physical parameters.</p> <p><b>W04</b> A student knows the resource of quantum nanostructures application in the nanodevices.</p>	K_W01 – K_W10

	Learning effects of the course	Relation of the learning effects to the specialization
Skills	<p><b>U01</b> A student can calculate the parameters of quantum nanostructures.</p> <p><b>U02</b> A student understands the physical principles of quantum nanostructures.</p> <p><b>U03</b> A student can determine the optimal parameters of quantum nanostructures needed for production of nanodevices.</p> <p><b>U04</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>	K_U01 – K_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.	K_K01 – K_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	14				28				1
Semester	2								
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 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
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-K6. 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-K6, 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-K6, 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-K6 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-K6 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> Quantum Wells, Wires, and Dots.</p> <p><b>W2.</b> Size and dimensionality effects</p> <p><b>W3.</b> Potential wells, partial confinement</p> <p><b>W4.</b> Properties dependent on density of states</p> <p><b>W5.</b> Preparation of quantum nanostructures</p> <p><b>W6.</b> Photochemical vapor deposition, photolithography</p> <p><b>W7.</b> Self-organized deposition and nanoimprinting</p> <p><b>W8.</b> Methods of Measuring Properties</p> <p><b>W9.</b> Applications. Infrared detectors, quantum dot lasers</p> <p><b>W10.</b> Nanomachines and Nanodevices.</p>
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**Literature:**

Compulsory reading	<p>P.Poole, Jr.Frank J. Owens Introduction to nanotechnology Charles,2003 by John Wiley&amp;Sons, Lnc.</p> <p>Молекулярно-лучевая эпитаксия и гетероструктуры, / ред. Л. Ченг, К.Плог..М., Мир, 1989.</p>
Recommended reading	<p>Davies J.H. The Physics of Low-Dimensional Semiconductors: An Introduction. Cambridge University Press, Cambridge, 1998.</p> <p>Lecture notes will be also provided.</p>

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

Contact hours	Lectures	42
	Seminars	
	Other (consultation, meetings)	23
Students' work hours (without the lecturer)	Reading books and preparation for the lectures	15
	Preparation for quizzes and exercises	10
	Preparation of an individual presentation	15
	Preparation to the exam	20
Total works' hours		125
ECTS credits 1 ECTS = 25 h		5