SYLLABUS 2017/2018

Level of study	Master's Course

Course title in Ukraine	Моделювання процесів у відкритих квантових системах		
Course title in English	Simulation of Processes in Open Quantum Systems		
Course code		ECTS credits	3
Lecturer(s)	Cand. Sci., Doc. Lyagushyn S.F. Email address:		

Course objectives (learning outcomes)	Familiarization with the methods of modern physics in studying of processes in systems which are influenced by the environment. The systems are exampled by the macroscopic classical electrodynamics (normal electromagnetic waves in media, plasma phenomena) and the theory of non-equilibrium processes (emitter system in the field, quantum optics) cases.

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	**W01** A student has a basic knowledge in general and quantum mechanic physics. **W02** A student understands foundations of theory of open quantum systems. **W03** A student comprehends physical principles of theoretical description of phenomena in open quantum systems. **W04** A student knows the general trends in modern theoretical methods of description of open quantum systems.	W01 – W10

	Learning effects of the course	Relation of the learning effects to the specialization
Skills	**U01** A student is able to use methods of quantum mechanics to describe the physical phenomena caused by the interaction of physical system with environment. **U02** A student is able to use theoretical knowledge in solving specific problems, calculations of physical phenomena in open quantum systems.	U01 – U07

	Learning effects of the course	Relation of the learning effects to the specialization
Social skills	**K01**. A student has the creativity and the ability to conceptual thinking. **K02** A student is able to present and justify the personal point of view. **K03** A student is able to use the information technologies for the communication with the scientific community. **K04** A student is aimed to expand personal knowledge and skills. **K05** A student has the legal erudition. **K06** 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)		Exam	
Contact hours	16			18								1	
Semester	1												

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	x
W02						x		x				x	x
W03						x		x				x	x
W04						x		x	x			x	x
U01							x	x				x	x
U02							x	x				x	x
K01						x		x	x			x	x
K02							x	x				x	x

K03							x	x	x			x	x
K04						x	x	x				x	x
K05												x	x
K06												x	x

Assessment criteria:

Grades	The grading scale will be as follows: 90 – 100 % - **A** including **A**- **excellent** (eq. in Ukraine:відмінно (very good)) 82–89 % : **B** including **B** – **very good** (eq. in Ukraine: добре (good)) 74–81 %: **C** including **C** - **good** (eq. in Ukraine: добре (good)) 64–73 %: **D** including **D** – **satisfactory** (eq. in Ukraine: задовільно (satisfactory)) 60–63 %: **E** including **E** – **acceptable** (eq. in Ukraine: задовільно (satisfactory)) < 59 %: **F failded** (eq. in Ukraine: незадовільно (unsatisfactory))
Criteria	**A.** 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. **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. **C.** 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. **D.** 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. **E.** A student knows only several terms and concepts mentioned in W1-W4, U1- U4 and K1-K4 and can solve only a simple problem. **F**. 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.

Course content (topic list):

Topics	1. Electromagnetic waves in media with dispersion. W1. The law of dispersion and polarization of waves. W2. Basics of optics of material media. W3. Normal waves in isotropic medium (non-chiral and chiral). 2. Physical processes in plasma. W4. Hydrodynamic model of plasma. W5. Normal electromagnetic waves in plasma. Debye screening. W6. Damping of plasma waves. 3. Consideration of interaction with the environment in kinetics of quantum systems. W7. General ideas of the reduced description method. The boson variables elimination method. W8. Quantum statistical states of electromagnetic field. Glauber–Sudarshan representation. W9. Nonclassical field states.

Literature:

Compulsory reading	1. Скалозуб В.В., Гулов О.В. Класична макроскопічна електродинаміка. – Дніпропетровськ: Вид-во ДНУ, 2010. – 168 с. 2. Бредов М.М., Румянцев В.В., Топтыгин И.Н. Классическая электродинамика. – М.: Наука, 1985. – 560 с. 3. Ландау Л.Д., Лифшиц Е.М. Электродинамика сплошных сред. Теоретическая физика: в 10 томах. — М. : Физматлит, 2008. – Т. 8. – 623 с. 4. Ахиезер А.И., Пелетминский С.В., Методы статистической физики/ – М.: Наука, 1977/ – 368 с. 5. Боголюбов Н.Н. (мл.), Шумовский А.С., Сверхизлучение. – Дубна: Изд-во ОИЯИ, 1987. – 88 с. 6. Килин С.Я. Квантовая оптика. Поля и их детектирование. – Москва: УРСС, 2003. – 176 с. 7. Lyagushyn S and Sokolovsky A. Description of field states with correlation functions and measurements in quantum optics in «Quantum Optics and Laser Experiments», S. Lyagushyn, Ed. Rijeka: InTech., 2012. – P. 3-24. 8. Батыгин В.В., Топтыгин И.Н. Сборник задач по электродинамике. – М.: Наука, 1970. – 503 с. 9. Сборник задач по теоретической физике / Под ред. Сенкевича А.А. – М.: Высшая школа, 1972. –336 с.
Recommended reading	10. Федорченко А.М. Теоретическая физика. Классическая электродинамика: Учебное пособие. – К.:Вища школа. Головное изд-во, 1988. – 382 с. 11. Памятных Е.А., Туров Е.А. Основы электродинамики материальных сред в переменных и неоднородных полях. – М.: Наука, Физматлит, 2000. – 240 с. 12. Александров А.Ф., Богданкевич Л.С., Рухадзе А.А. Основы электродинамики плазмы. – М.:Высшая школа, 1978. – 408 с. 13. Тамм И.Е. Основы теории электричества. – М.: Наука, 1989. – 504 с. 14. Киржниц Д.А. Лекции по физике. – М.: Наука, 2006 – 248 с. 15. Боголюбов Н.Н.(мл.), Козеровски М., Чан Куанг, Шумовский А.С. Новые эффекты в квантовойэлектродинамике // ЭЧАЯ, Т. 19, вып. 4, С. 831-863, 1988.

Estimation of the total working time of students:

Contact hours	Lectures	34
	Seminars	
	Other (consultation, meetings)	6
Students' work hours (without the lecturer)	Reading books and preparation for the lectures	10
	Preparation to the seminar	
	Preparation of an individual presentation	5
	Preparation to the test	20
Total works' hours		75
ECTS credits 1 ECTS = 25 h		3