SYLLABUS 2017/2018

Level of study	Master's Course

Course title in Ukraine	Монте-Карло симуляції у фізиці на гратках		
Course title in English	Selected Monte Carlo Simulations Methods in Physics		
Course code		ECTS credits	4
Lecturer(s)	Dr.Sci., prof. Skalozub V.V. Email address: fttkaf@i.ua		

Course objectives (learning outcomes)	The purpose of the special course is to master the Monte Carlo method and its use for a broad course of nuclear physics and high energy physics. The objectives of the special course are: – study of the Monte Carlo method in relation to the problem of transfer of elementary particles in media, – training students to write programs for modeling processes of high-energy physics and nuclear physics, – acquisition of skills in solving theoretical and experimental tasks of various physical disciplines, such as quantum mechanics, nuclear and atom physics, radiation safety, and others.

Prerequisites:

Knowledge	The material of the this course is based on earlier knowledge acquired in the courses "Theory of Probabilities", "Physics of the nucleus", "Quantum mechanics" and special course "Statistical processing of physical information".
Skills	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	**W01** A student knows the Monte Carlo method, which is used in elementary particle physics. **W02** A student knows the Methods for measuring physical quantities and methods for estimating measurement errors in physical and special workshops. **W03** A student knows the methods of numerical estimation of the quantities characteristic of elementary particle physics.	W01 – W10

	Learning effects of the course	Relation of the learning effects to the specialization
Skills	**U01** A student use the technical means of automating the experiment. **U02** A student process and analyze the obtained results, to create mathematical models and software. **U03** A student is planning and organizing scientific research, application of appropriate experimental and theoretical methods. **U04** A student is able to Interpretation of the results of experimental studies.	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	18		16		34		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	Other
W01								x				x	
W02								x	x			x	
W03								x	x			x	
U01							x	x				x	
U02							x	x				x	
U03							x	x				x	
U04							x	x	x			x	
K01								x	x			x	
K02							x	x	x			x	
K03							x	x	x			x	
K04							x	x	x			x	
K05							x	x				x	
K06							x	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. Computer experiment and its main components. 2. Auxiliary theorems of mathematical statistics. and probability theory. 3. Getting random and pseudorandom numbers. 4. Methods of generating pseudorandom numbers of arbitrary distributions. 5. Physical model of the transfer task. 6. Mathematical model of the passage of particles through matter. 7. Solving physical problems by the Monte Carlo method. 8. Scheme of using MMK in the transfer task. 9. Algorithms for solving the problem of transporting particles in matter.

Literature:

Compulsory reading	1. Ермаков, С.М. Метод Монте-Карло и смежные вопросы/ С.М. Ермаков — М.: Наука. Гл. ред. физ.-мат. литературы, 1971. – 328 с. 2. Биндер К. Общие вопросы теории и техники статистического моделирования методом Монте-Карло: Методы Монте-Карло в статистической физике/ К.Биндер. — М.: Мир, 1982.- 400с. 3. Ермаков, С.М., Михайлов Г.А. Статистическое моделирование/ С.М.,Ермаков, Г.А. Михайлов. — М.:Наука,1982. — 296 с. 4. Гулд, Х.. Компьютерное моделирование в физике: В 2-х частях. / Х.Гулд, Я. Тобочник. Часть 1 — М.: Мир, 1990. — 349 с. 5. Гулд, Х. Компьютерное моделирование в физике: В 2-х частях. / Х.Гулд, Я. Тобочник. Часть 2— М.: Мир, 1990— 400 с. 6. Ивченко, Г. И. Математическая статистика/ Г.И.Ивченко, Ю. И. Медведев Учеб. пособие для вту- зов. — М.: Высш. шк., 1984. — 248 с. 7. GEANT4 User's Documents: Physics Reference Manual.http://geant4.web.cern.ch/geant4.
Recommended reading	1. Соболь, И.М. Метод Монте-Карло / И.М. Соболь. — М.: Наука ,1978. 2. Гмурман, В. Е. Теория вероятностей и математическая статистика: Учеб. пособие для вузов/В. Е. Гмурман. — 9-е изд., стер. — М.: Высш. шк., 2003. — 479 с. 3. Физические основы защиты от излучений (защита от ионизирующих излучений, том 1)/ Н.Г. Гусев [и др.] – М.: Энергоатомиздат,1989. 4. Валантэн, Л. Субатомная физика: ядра и частицы/ Л. Валантэн. — М:Мир, 1986. 5. Ландау, Л.Д., Лифшиц Е.М. Квантовая механика (теоретическая физика, т.3)/ Ландау, Л.Д., Лифшиц Е.М. — М.: Наука, 1989. 6. Хеерман Д.В. Методы компьютерного эксперимента в теоретической физике/ Д.В. Хеерман . — М.: Наука. 1990. . — С.134-144.

Estimation of the total working time of students:

Contact hours	Lectures	34
	Seminars	
	Other (consultation, meetings)	16
Students' work hours (without the lecturer)	Reading books and preparation for the lectures	10
	Preparation to the seminar	
	Preparation of an individual presentation	20
	Preparation to the exam	20
Total works' hours		100
ECTS credits 1 ECTS = 25 h		4