EXPERIMENT PLANNING
COURSE SYLLABUS

Code and name of specialty	121 Software Engineering 122-Computer Science 126-Information Systems and technologies	**Institute / faculty**	Faculty of Computer Science and Software Engineering
Program name	Software Engineering Computer Science and Intelligent Systems Information Systems Software	**Department**	Software Engineering and Management Information Technologies
Type of program	Educational and Professional	**Language of instruction**	Ukrainian, English

LECTURERS

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Ihor Hamaiun

Ph Doctor of Technical Sciences, Associate Professor, Department (05.13.06 - automated control systems and advanced information technologies),
professor of departments.
Work experience - with 1975 p. Author (co-author) of more than 120 scientific and educational publications.
(https://www.scopus.com/autthid/detail.uri?authorid=6506853631; ORCID: https://orcid.org/0000-0003-2099-4658/
Leading lecturer of courses: “Fundamentals of scientific research ” (lectures), “Mathematical models and systems analysis ” (lectures and laboratory work)

Svetlana Yershova

Senior lecturer of the department. Number of scientific and educational publications - more than 20.
(Google Scholar: https://scholar.google.com.tw/; http://ceur-ws.org/Vol-2753/paper25.pdf ; ORCID: https://orcid.org/0000-0003-3893-117X)
Leading lecturer of courses : "Artificial intelligence systems", "Methods of empirical information processing", "Economics and organization of software production"

GENERAL DESCRIPTION OF THE COURSE

Summary	The course "Experiment planning" is an academic discipline from the profiled package of disciplines 01 "Research and Development”. It is taught in the seventh semester in the amount of 120 hours.(4 ECTS credits), in particular: lectures – 16 hours., labs – 16 hours., independent work-88 hours. The course provides two tests. The discipline ends with a test.
Course objectives	The purpose of studying the discipline is to form in specialists theoretical knowledge and practical skills on the basics of experiment planning, the ability to apply probabilistic and statistical methods in their practice. To acquaint students with the classical theory of planning a regression experiment (linear and nonlinear regression), methods of planning an extreme experiment, an experiment to test hypotheses, planning a simulation experiment; develop skills and abilities to choose methods for solving typical experimental planning problems.

Types of classes and control	Lectures, laboratory classes, self-study. Continuous assessment – labs, intermediate assessment, tests. Final assessment – tests.
Term	7

Student workload (credits) / Type of course		**Student workload (credits) / Type of course**		**Student workload (credits) / Type of course**		**Student workload (credits) / Type of course**	

Program competences	121GC01. Ability to abstract thinking, analysis and synthesis. 121-GC 02. Ability to apply knowledge in practical situations. 121-GC 05. Ability to learn and master modern knowledge. 121-GC 06. Ability to search, process and analyze information from various sources. 121-PC20. Ability to apply fundamental and interdisciplinary knowledge to successfully solve software engineering problems. 121-PC25. Ability to reasonably select and master software development and maintenance tools. 121-PC26. Ability to algorithmic and logical thinking. 122-GC1. Ability to abstract thinking, analysis and synthesis. 122-GC2. Ability to apply knowledge in practical situations. 122-GC3. Knowledge and understanding of the subject area and understanding of professional activity. 122-GC6. Ability to learn and master modern knowledge. 122-GC7. Ability to search, process and analyze information from various sources. 122-PC1. Ability to mathematically formulate and study continuous and discrete mathematical models, justify the choice of methods and approaches for solving theoretical and applied problems in the field of computer science, analysis and interpretation. 122-PC3. Ability to think logically, build logical conclusions, use formal languages and models of algorithmic calculations, design, develop and analyze algorithms, evaluate their efficiency and complexity, solvability and insolvability of algorithmic problems for adequate modelling of subject areas and creation of software and information systems. 122-PC4. Ability to use modern methods of mathematical modelling of objects, processes, and phenomena, to develop models and algorithms for the numerical solution of mathematical modelling problems, to take into account the errors of approximate numerical solution of professional problems. 122-PC5. Ability to provide a formalized description of operations research tasks in organizational, technical, and socio-economic systems for different purposes, to determine their optimal solutions, to build optimal management models taking into account changes in the economic situation, to optimize management processes in different systems and hierarchies. 122-PC6. Ability to think systematically, apply the systems analysis methodology to study complex problems of different nature, methods of formalization and solution of system problems with conflicting goals, uncertainties, and risks. 122-PC7. Ability to apply the theoretical and practical basics of methodology and modelling technology to study the characteristics and behavior of complex objects and systems, to conduct computational experiments with processing and analysis of results. 122-PC18. Ability to apply modern methods of decision-making theory, including methods of ranking, formation, and coordination of collective expert assessments, multi-criteria optimization etc., to build intelligent management systems. 122-PC19. Ability to comprehensively use for the creation of intelligent management systems methods of mathematical modelling and analysis of complex systems, methods of modelling and analysis of business processes, information technologies for the management of business systems. 126-GC 1. Ability to abstract thinking, analysis and synthesis.

	126-GC 2. Ability to apply knowledge in practical situations. 126-GC 3. Ability to understand the subject area and professional activity. 126-GC 5. Ability to learn and master modern knowledge. 126-GC 6. Ability to search, process and summarize information from various sources. 126-GC 7. Ability to develop and manage projects. 126-GC 8. Ability to evaluate and ensure the quality of work performed. 126-PC 1. Ability to analyze the object of design or operation and its subject area. 126-PC 4. Ability to design, develop and use tools for the implementation of information systems, technologies and infocommunications (methodological, informational, algorithmic, technical, software and others) 126-PC 9. Ability to develop business solutions and evaluate new technological proposals.

Learning outcomes	**Teaching and learning methods**	**Forms of assessment (continuous assessment CAS, final assessment FAS)**
121:		
PLO 01. Analyze, purposefully search for and select the necessary information and reference resources and knowledge to solve professional problems, taking into account modern advances in science and technology.	Interactive lectures with presentations, discussions, laboratory classes, teamwork, case method, student feedback method, problem-based learning.	Written individual assignments for laboratory works (CAS), assessment of knowledge in laboratory classes (CAS), express surveys (CAS), online tests (CAS), final/semester control in the form of a semester test, according to the schedule of the educational process (FAS)
PLO 05. Know and apply relevant mathematical concepts, methods of domain, system and object-oriented analysis and mathematical modelling for software development.		
PLO 06. Ability to select and use the appropriate task methodology of software development.		
PLO 10. Conduct a pre-project survey of the subject area, systematic analysis of the design object.		
PLO 05. Being motivated to choose programming language sand development technologies to solve problem so soft ware design and maintenance.		
PLO 18. Know and be able to apply information technology processing, storage an d transmission of data.		
PLO 23. Be able to document and present the results of software development.		
122:		
PLO1. Apply knowledge of the fundamental forms and laws of abstract-logical thinking, the basics of the methodology of scientific knowledge, forms and methods of extraction, analysis, processing, and synthesis of information in the subject area of computer science.		

PLO2. Use tools for developing client-server applications, design conceptual, logical, and physical models of databases, develop and optimize database queries, create distributed databases, repositories and showcases of databases, and knowledge bases, including those based on cloud services, using web programming languages.		
PLO6. Use methods of numerical differentiation and integration of functions, solution of ordinary differential and integral equations, features of numerical methods and possibilities of their adaptation to engineering problems, have skills of software implementation of numerical methods.		
PLO7. Understand the principles of modelling organizational and technical systems and operations; use methods of operations research, solve single- and multicriteria optimization problems of linear, integer, nonlinear, stochastic programming.		
PLO8. Use the methodology of system analysis of objects, processes, and systems for the tasks of analysis, prediction, management, and design of dynamic processes in macroeconomic, technical, technological, and financial objects.		
PC18. Ability to apply modern methods of decision-making theory, including methods of ranking, formation, and coordination of collective expert assessments, multi-criteria optimization etc., to build intelligent management systems.		
PC19. Ability to comprehensively use for the creation of intelligent management systems methods of mathematical modelling and analysis of complex systems, methods of modelling and analysis of business processes, information technologies for the management of business systems.		
122-PLO20. Develop the architecture of software systems and their particular components during the construction of intelligent management systems in various fields, as well as manage the life cycle of intelligent management systems software.		
122-PLO11. Have the skills to manage the life cycle of software, products, and services of information technology under the requirements and restrictions of the customer, be able to develop project documentation (feasibility study, technical task, business plan, agreement, contract).		
126:		

PLO 5. Argue the choice of software and hardware for the creation of information systems and technologies based on the analysis of their properties, purpose and technical characteristics, taking into account the requirements for the system and operating conditions; have the skills to debug and test software a nd hardware of information systems and technologies.		
PLO 6. Demonstrate knowledge of the current level of information systems technology, practical skills of programming and use of applied and specialized computer systems and environments for their implementation in professional activities.		
PLO 7. Justify the choice of technical structure and develop appropriate software that is part of information systems and technologies.		
PLO 8. Apply the rules of design materials of information systems and technologie s, know the composition and sequence of design work, taking into account the re quirements of relevant legal documents for implementation in professional activi ties.		

ASSESSMENT AND GRADING

Ranges of points corresponding to grades

Total score (points) for all types of learning activities	ECTS grading scale	The national grading scale
90-100	A	excellent
82-89	B	good
74-81	C	
64-73	D	satisfactory
60-63	E	
35-59	FX	Unsatisfactory (with the exam retake option)
0-34	F	Unsatisfactory (with mandatory repetition of the course)

Allocation of grade points

100% Final assessment as a result of Final test (40%) and Continuous assessment (90%).
40% Final test
60% Continuous assessment:
Test №1 (10%)
Test №2 (10%)
Laboratory works (20%)
Laboratory work №1 (5%)
Laboratory work №2 (5%)
Laboratory work №3 (5%)
Laboratory work №4 (5%)
Self-study (20%)

Course policy	Students must attend all classes according to the study schedule and adhere to the norms of academic ethics. To study the course, students need to have their personal computer and (or) use computers of the computer center at the department. Students must work with compulsory and recommended reading, including Internet resources. Students must complete and submit all laboratory works during the semester in which the course is taught, before the examination session. The final assessment is not carried out without the personal presence of students.

COURSE STRUCTURE AND CONTENT

Topic 1	Fundamentals of experimental research. Definition of system.			На	Registration of results of scientific researches.

	experiment, method of experiment. Types of experiments. Experiment planning. Factors, reviews and requirements for them. Experiment planning.				
Topic 2	Planning and conducting experiments with models. Factor space. Plan and mathematical model of the experiment. Problems of planning simulation experiments. Features of planning experiments to test hypotheses.	**Laboratory work 1**	Development of a plan for a multifactorial experiment		Types of errors and their classification. Direct and indirect measurements and errors. Evaluation of the homogeneity of the experiment. Ways to increase the accuracy of the mathematical model.
Topic 3	Processing and interpretation of results. Evaluation of the accuracy and statistical significance of research results.	**Laboratory work 2**	Statistical processing of experimental results		Least squares method for orthogonal plans
Topic 4	Mathematical processing of experimental results. Plans for analysis of variance.	**Laboratory work 3**	Construction of plans and models with nonlinearities		Properties of an orthogonal factorial experiment. Orthogonal plans of the first order. Naturalization of the plan.
Topic 5	Methods of reducing variance. The method of complementary quantities. "Russian roulette" and breaking the sample. Total random numbers.	**Laboratory work 4**	Explore the features and limitations of interface formats.		Three-level plans for a complete factorial experiment.
Topic 6	Factor plan. Complete factorial experiment. Two-level factor plan. Factor plan 2k. Fractional factor plan.				Retail plans of the second order.
Topic 7	Orthogonal central compositional plans.				Implementation of orthogonal plans.
Topic 8	Strategy of multifactorial experimental researches.	**Laboratory work 1**	Development of a plan for a multifactorial experiment		

RECOMMENDED READING

Compulsory	1 Важинський, С. Е., Щербак, Т. І. (2016). Методика та організація наукових досліджень: навч. посібник. Суми: СумДПУ ім. А. С. Макаренка, 260 с. 2 Грищук, Ю. С. (2006). Основи наукових досліджень: навч. посібник. Харків: НТУ «ХПІ», 232 с. 3 Організація наукових досліджень: навч. посібник. Суми: Університетська книга, 2011, 224 с. 4 Кононенко, В., Нечаєв, В., Берідзе, Т. (2005). Теорія планування експерименту: Кондор, 232 с. 5 Назаренко, Л. А. (2018). Планування і обробка результатів експерименту: конспект лекцій. Харків: ХНУМГ, 163 с. 6 Томашевський, В. М. (2005). Моделювання систем. Київ: Видавнича група BHV, 352 с.	**Optional**	1 Білуха, М. Т. (2009). Методологія наукових досліджень: підручник. Київ: АБУ, 480 с. 2 Бикел, П., Доксам, К. (2013). Математическая статистика. Москва: Финансы и статистика, 254 с. 3 Льюинг, Л. (2011). Идентификация систем. Теория для пользователей. Москва: Физматизд, 432 с. 3 Статюха, Г. О., Складанний, Д. М., Бондаренко, О. С. (2011). Вступ до планування оптимального експерименту: навч. посібник. Київ: ІВЦ ”Політехніка”, 117 с.

Academic integrity

Graduate students are expected to adhere to the Code of Ethics of Academic Relations and Integrity” of NTU “KhPI”.

The content of this syllabus is consistent with the