Syllabus
Course Program

Planning of the experiment

Specialty
121 – Software Engineering
122 - Computer Science

Institute
Institute of Computer Science and Information Technology

Educational program
Software Engineering

Department
Software Engineering and Management Intelligent Technologies (321)

Level of education
Bachelor's level

Course type
Special (professional), Mandatory

Semester
6

Language of instruction
English, Ukrainian

Lecturers and course developers

Gamayun Igor Petrovych
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Doctor of Technical Sciences (05.13.06 - Automated Control Systems and Progressive Information Technologies), Professor, Head of the Department of PIITU.
The number of scientific and educational publications is more than 120.
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More about the lecturer on the department's website

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Prepared and published more than 20 publications.
Developed and taught more than 15 different training courses
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Scopus (Web of Science): https://ceur-ws.org/Vol-2753/paper25.pdf https://www.scopus.com/record/display.uri?eid=2-s2.0-85134395161&origin=resultslist&sort=plf-f&retries=1, https://ceur-ws.org/Vol-3403/paper37.pdf.
More about the lecturer on the department's website

General information

Summary

Academic discipline is a selective discipline from the profiled package of disciplines VP01 "Research and Development" in specialties 121 "Software Engineering", 122 "Computer Science". Academic discipline is aimed at forming an integral system of theoretical and practical knowledge, which helps to model, analyze and solve problems in the field of experiment planning; and also aimed at developing the logical

thinking of a specialist, at promoting the formation of the student's skills and abilities to independently study problems, the ability to apply knowledge in practical situations.

Course objectives and goals

The purpose of studying the discipline is to form specialists' theoretical knowledge and practical skills in the basics of experiment planning, the ability to apply probabilistic-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 on testing hypotheses, planning a simulation experiment; develop skills and abilities to choose methods for solving typical problems of planning an experiment.

Format of classes

Lectures, laboratory works, independent work, consultations. Final control – standings.

Competencies

121 – Software Engineering

К01. Ability to think abstractly, analyze and synthesize.
К02. Ability to apply knowledge in practical situations.
К03. Ability to communicate in the state language both orally and in writing.
К04. Ability to communicate in a foreign language both orally and in writing.
К05. Ability to learn and master modern knowledge.
К06. Ability to search, process and analyze information from various sources.
К20. Ability to apply fundamental and interdisciplinary knowledge to successfully solve software engineering problems.
К25. Ability to reasonably choose and master the tools for software development and maintenance.
К26. Ability to think algorithmically and logically.

122 – Computer Science

GC1. Ability to think abstractly, analyze and synthesize.
GC2. Ability to apply knowledge in practical situations.
GC3. Knowledge and understanding of the subject area and understanding of professional activities.
GC4. Ability to communicate in the state language both orally and in writing.
GC5. Ability to communicate in a foreign language.
GC6. Ability to learn and master modern knowledge.
GC7. Ability to search, process and analyze information from various sources.
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.
PC3. Ability to think logically, build logical conclusions, use formal languages and models of algorithmic computing, design, develop and analyze algorithms, evaluate their effectiveness and complexity, solvability and intractability of algorithmic problems for adequate modeling of subject areas and creation of software and information systems.
PC4. Ability to use modern methods of mathematical modeling of objects, processes and phenomena, to develop models and algorithms for numerical solution of mathematical modeling problems, to take into account the errors of approximate numerical solution of professional problems.
PC5. Ability to carry out a formalized description of the tasks of researching operations in organizational, technical and socio-economic systems for various purposes, to determine their optimal solutions, to build models of optimal management taking into account changes in the economic situation, to optimize management processes in systems of various purposes and hierarchy levels.
PC6. Ability to think systematically, apply the methodology of system analysis to study complex problems of different nature, methods of formalizing and solving systemic problems with conflicting goals, uncertainties and risks.
PC7. Ability to apply the theoretical and practical foundations of modeling methodology and technology

to study the characteristics and behavior of complex objects and systems, to conduct computational experiments with processing and analysis of results.
PC18. Ability to apply modern methods of decision-making theory, including: methods of ranking, formation and coordination of collective expert opinions, multi-criteria optimization and others, to build intelligent control systems.
PC19. Ability to comprehensively use methods of mathematical modeling and analysis of complex systems, methods of modeling and analysis of business processes, information technology for managing business systems to create intelligent control systems.

Learning outcomes

121 – Software Engineering

PLO01. Analyze, purposefully search and select information and reference resources and knowledge necessary for solving professional problems, taking into account modern achievements of science and technology.
PLO05. To know and apply relevant mathematical concepts, methods of domain, system and object-oriented analysis and mathematical modeling for software development.
PLO06. Ability to select and use a software development methodology appropriate to the task.
PLO10. Conduct a pre-project survey of the subject area, system analysis of the design object.
PLO15. Motivated to choose programming languages and development technologies to solve the problems of creating and maintaining software.
PLO18. To know and be able to apply information technologies for data processing, storage and transmission.
PLO23. Be able to document and present the results of software development.

122 – Computer Science

PLO1. To apply knowledge of the basic forms and laws of abstract and logical thinking, the basics of the methodology of scientific knowledge, forms and methods of extracting, analyzing, processing and synthesizing information in the subject area of computer science.
PLO2. To use the modern mathematical apparatus of continuous and discrete analysis, linear algebra, analytical geometry in professional activities to solve theoretical and applied problems in the design and implementation of information objects.
PLO6. To 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, to have skills in software implementation of numerical methods.
PLO7. Understand the principles of modeling organizational and technical systems and operations; use methods of researching operations, solving single and multi-criteria optimization problems of linear, integer, nonlinear, stochastic programming.
PLO8. To use the methodology of system analysis of objects, processes and systems for the tasks of analysis, forecasting, management and design of dynamic processes in macroeconomic, technical, technological and financial objects.
PLO18. To apply modern methods of decision-making theory to build intelligent control systems, including methods of ranking, formation and coordination of collective expert opinions, multi-criteria optimization, and others.
PLO19. To create intelligent management systems using methods of mathematical modeling and analysis of complex systems, methods of modeling and analysis of business processes, information technology management of business systems.

Student workload

The total volume of the course is 120 hours (3 ECTS credits): lectures – 32 hours, laboratory classes – 16 hours, independent work– 72 hours.

Course prerequisites

The course "Experiment Planning" is based on the disciplines "Probability Theory and Mathematical Statistics", "Mathematical Models and Systems Analysis"

Features of the course, teaching and learning methods, and technologies

Teaching and learning methods:
interactive lectures with presentations, discussions, laboratory classes, teamwork, case method, student feedback, problem-based learning.

Forms of assessment:
written individual assignments for laboratory work (CAS), assessment of knowledge in laboratory classes (CAS), express surveys (CAS), online tests (CAS), final/semester control in the form of a semester exam, according to the schedule of the educational process (FAS).

Program of the course

Topics of the lectures

Topic 1.
Fundamentals of experimental research. Definition of the system, experiment, experiment method. Types of experiments. Preliminary experiment. Data quality assessment. Evaluation of experimental results.
Topic 2. Planning and conducting experiments.
Justification for choosing a plan. Levels of variation. Number of experiments. Factors, reviews and requirements for them. Factor space. Plan and mathematical model of the experiment. Problems of planning simulation experiments. Features of planning experiments to test hypotheses.
Topic 3. Processing results.
Mathematical processing of experimental results. Evaluation of the accuracy and statistical significance of research results. Plans for analysis of variance.
Topic 4. Methods for reducing dispersion.
Methods for reducing dispersion. The method of complementary quantities. "Russian roulette" and sample breaking. Common random numbers.
Topic 5. Factor plans. Factor plan.
A complete factor experiments. Method of processing the results of experiments on full factor plans. Two-level factor plan. Factor Plan 2k. Fractional Factor Plan.
Topic 6. Orthogonal central-compositional plan.
Orthogonal central-compositional plans.
Topic 7. Multivariate experimental studies.
Basic concepts. Strategy of multivariate experimental research. Analysis of results. Optimize the results of a multivariate experiment.

Topics of the workshops

Workshops are not provided within the discipline.

Topics of the laboratory classes

Topic 1.
Develop a multifactor experiment plan
Topic 2.
Statistical processing of experiment results.
Topic 3.
Building plans and models with nonlinearities
Topic 4.
Least squares model development for orthogonal plans.

Self-study

Students are recommended additional materials (videos, articles) for self-study and processing.

Course materials and recommended reading

Key literature

1. Лапач С.М. Теорія планування експериментів: Виконання розрахунково-графічної роботи [Електронний ресурс]: навч. посіб. для студ. спеціальності 131 «Прикладна механіка», спеціалізації «Технологія машинобудування» / С.М. Лапач; КПІ ім. Ігоря Сікорського. – Електронні текстові данні (1 файл: 3,31 Мбайт), – Київ: КПІ ім. Ігоря Сікорського, 2020, 86 с.
2. Назаренко Л.А. Планування і обробка результатів експерименту. Конспект лекцій/Л.А. Назаренко, – Харків: ХНУМГ, 2018, 163 с.
3. Пасічник В.В., Виклюк Я.І., Камінський Р.М. Моделювання складних систем/В.В.Пасічник, Я.І. Виклюк, Р.М. Камінський., –Університет "Україна", 2021, 404с.
4. Пузир Г., Крашенінін О., Жовтий Ю. Планування експерименту під час наукових досліджень / Г. Пузир, О. Крашенінін, Ю.Жовтий. - Х: 2020, 52 с.
5. Dean Angela, Morris Maks, Slufken John, Bingham Derec CTC Handbooks of modern Statistical Methods/ Angela Dean, Maks Morris, John Slufken, Derec Bingham, - Chapman and Hall, 2020, 960 p.

Additional literature

1. Moffat Robert J., Henk Roy W. Planning and executing credible Experiments/ Robert J. Moffat, Roy W. Henk, -Wiley, 2021.- 320 p.
2. Coleman Renita Designing Experiments for Social Sciences / Renita Coleman, - SAGE Publication, 2018, 408 p.
3. Santner Thomas J., Williams Brian J., Notz William I. The Designing and Analysis of Computer Experiments/ Thomas J. Santner, Brian J. Williams STHDA, William I. Notz, - Springer, 2018, 452 p.
4. Dean Angela, Voss Daniel, Draguljc Danel Designing and Analysis of Experiments / Angela Dean, Daniel Voss, Danel Draguljc, - Springer, 2017, 865 p.
5. Cochran William G., Cox Gertrude M. Experimental Designs/ William G. Cochran, Gertrude M. Cox, - Springer, 320 p.

Assessment and grading

Criteria for assessment of student performance, and the final score structure

100% of the final grade consists of the results of the assessment in the form of an exam (40%) and current assessment (60%):
- 4 laboratory works (5% each);
- 2 tests (10% each);
- independent work (30%).

Grading scale

Total points	National	ECTS
90–100	Excellent	A
82–89	Good	B
75–81	Good	C
64–74	Satisfactory	D
60–63	Satisfactory	E
35–59	Unsatisfactory (requires additional learning)	FX
1–34	Unsatisfactory (requires repetition of the course)	F

Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.

Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website: http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/

Approval

Approved by 11.04.2023

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