



Syllabus Course Program

Fundamentals of Scientific Research

Specialty

122 – Computer science

Institute

Institute of Computer Modeling, Applied Physics and Mathematics

Educational program

Computer science. Modeling, design, and computer graphics

Department

Computer modeling of processes and systems

Level of education

Master's level

Course type

Professional training, Mandatory,

Semester

1

Language of instruction

English

Lecturers and course developers



Breslavsky Dmytro

dmytro.breslavsky@khpi.edu.ua

Doctor of Technical Science.

Head of Department of Computer Modeling of Processes and Systems
Professor at Control Systems and Processes

The principal scientific results have been obtained in the field of creep theory and continuum mechanics of damage, cyclic and shock deformation, the application of the finite element method for solving physically nonlinear problems of mechanics, and the development of specialized software tools for computer simulation of thermomechanical processes. The author has more than 200 scientific publications, co-authored 5 scientific monographs, and is the recipient of the CEGB Award for the best scientific publication in the journal Strain Analysis (United Kingdom).

[More about the lecturer on the department's website](#)



Palamarchuk Pavlo

pavlo.palamarchuk@infiz.khpi.edu.ua

PhD Student, Department of Computer Modeling of Processes and Systems

Currently working on a dissertation on the topic 'Development of a methodology for stress-strain calculations and wear of structural elements'.
The author has 3 scientific publications.

General information

Summary

The course is devoted to the provision of the required amount of fundamental and practical knowledge in the field of methodology and organization of scientific research and preparation for independent solving of problems in the process of scientific activity. Provision and assimilation of the required amount of fundamental and practical knowledge in the field of methodology and organization of scientific research in order to successfully complete the master's thesis

Course objectives and goals

Understanding the structure and main components of scientific research. Practical skills in preparing the descriptions of research work, including literature survey, problem statements, results presentation etc.

Format of classes

Workshops, self-study work, course project, consultations. The final control is a tests.

Competencies

To understand the ways of development of modern scientific thought and to possess the general scientific knowledge necessary for the formulation of a systematic scientific outlook. To be able to search and analyze scientific sources on the selected topic of research. Know how to carry out scientific research in accordance with the methodology of scientific research based on step-by-step technology. To be able to apply the methodology of scientific knowledge, forms and methods of analysis, processing and synthesis of information in the subject area of Computer Sciences. To be able to formalize the obtained scientific results in the form of a scientific publication and a master's thesis.

Learning outcomes

Course outcomes. Practical skills in organization of scientific research. Knowledge of preparation the literature surveys and problem statements. Practical skills in processing of research data.

Student workload

The total volume of the course is 90 hours (3 ECTS credits): practical classes - 32 hours, self-study - 58 hours.

Course prerequisites

Knowledge of basic IT technologies, programming as well as basic course of numerical methods.

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

The course contains description of methodology and practical approaches in order to help students to start their investigations in the field of master's thesis preparation. The obtained results are discussed in current mode and in special workshops

Program of the course

Topics of the lectures

Not included in the curriculum

Topics of the workshops

Topic 1. Introduction

Subject and purpose of the course. The concept, functions and meaning of science. Concept, purpose, features of research work. Classification of objects of scientific research. Classification of scientific research. Principles of organization of scientific work. Verification and falsification principles.

Topic 2. Scientific research

The main stages of scientific research. Characteristics of the main stages of the research. Methods of scientific research. General requirements for research methods

Topic 3. Diploma thesis as research project

Contents of Master Diploma thesis. General characteristics of the master's thesis. Determination of the main components of the master's thesis. Research topic. Relevance of research. Formulation of the title. Definition of the object and subject of research. Determination of the purpose and objectives of the research. Scientific novelty. Practical significance of the obtained results. Demands to the structure and contents. Mathematical and informational backgrounds.

Topic 4. The role of literature surveys in research activities

Types of surveys. Structure and goals. Scientific databases. Databases of scientific publications. Analysis of the scientific papers

Topic 5. Basic tools of mathematical data processing

Main stages of data analysis. Use of mathematical modelling in the research process and in the process of results presentation. Use of mathematical software.

Topic 6. Data processing 1

Mathematical background of the interpolation methods. Examples.

Topic 7. Data processing 2

Mathematical background of the regression analysis. Linear regression. Examples.

Topic 8. Data processing 3

Mathematical background of the regression analysis. Nonlinear regression. Examples.

Topic 9. Technology of research work

Technology of research work and elements of scientific argumentation. Phases of organization of intellectual training. Elements of research argumentation. Features of modern scientific research.

Topic 10. System approach

The systematic approach as a direction of the methodology of scientific knowledge. The history of the development of the system approach. The role of the system approach in cognition. General provisions of the system approach. Basic principles of the system approach.

Topic 11. Logical laws and rules in scientific research

The logic of cognitive search in scientific research and general scientific principles of research. The logic of scientific research. Application of logical laws and rules in scientific research. Formal logical laws

Topic 12. Problem statement process in IT

Mathematical problem statements. Primary description of a problem. Modelling languages. Use of UML diagrams and flow charts for problem presentation.

Topic 13. Description of methods and algorithms

Logical structure of research work's description. Rules and recommendations for describing the elements of methods and algorithms developed in the thesis. Presentation of the mathematical methods. Presentation of algorithms.

Topic 14. The approach and rules for the description of research results

Rules for the description of research results. Analysis and description of tables. Analysis and description of plots and diagrams. Preparation of conclusions.

Topic 15. Seminar on student's literature surveys results

Discussion and correction of presentations

Topic 16. Seminar on student's problem statements results

Discussion and correction of presentations

Topics of the laboratory classes

Not included in the curriculum

Self-study

Performing of the individual literature survey due to the directions of research theme of master's thesis. Chapter with the text of the survey. Presentation. Report on the seminar.

Performing the text of problem statement of master's thesis. Text of the chapter. Presentation. Report on the seminar.

Course materials and recommended reading

1. Tripathy P., Tripathy P. K. Fundamentals of research. A dissective view. – diplom. de, 2015.
2. Anderson G., Arsenault N. Fundamentals of educational research. – Routledge, 2005.
3. Nayak J. K., Singh P. Fundamentals of research methodology problems and prospects. – SSDN Publishers & Distributors, 2021.
4. Fink A. Conducting research literature reviews: From the internet to paper. – Sage publications, 2019.
5. Steward B. Writing a literature review //British Journal of Occupational Therapy. – 2004. – T. 67. – №. 11. – C. 495-500.
6. Bolderston A. Writing an effective literature review //Journal of Medical Imaging and Radiation Sciences. – 2008. – T. 39. – №. 2. – C. 86-92.

Assessment and grading

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

Final score structure includes successive preparation the results of individual tasks in data analysis methods (40), course project - preparation the literature survey (50) and description of problem statement (10).

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



Head of the department
Dmytro BRESLAVSKY



Guarantor of the educational program
Oleksii VODKA