# A COMPREHENSIVE PROGRAM OF PRACTICAL TRAINING

COURSE SYLLABUS

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

## GENERAL DESCRIPTION OF THE COURSE

**Summary**

The comprehensive program of practical training of students is a document, the main purpose of which (according to the Regulations on the procedure of practical training of applicants for the higher education of the National Technical University "Kharkiv Polytechnic Institute" p. 8.1.1) is to acquaint applicants for higher education and other participants in the educational process with a holistic system of practical training of the educational program "Computer Science and Intelligent Systems". An integrated approach to the organization of practical training of students is provided by the presence of 2 stages of practical training, which are listed in the table.

| Code | Components of the educational program | Number of credits | Form of final control | |
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| | | | Exams (terms) | Credits (terms) |
| PT 25 | Project (practice) | 6.0 | | 6 |
| PT 26 | Pre-graduation practice | 6.0 | | 8 |

**Course objectives**

Improving efficiency and quality in the development, implementation, maintenance, and research of intelligent systems requires a rational combination of theoretical knowledge of specialists with the ability to solve practical problems. Achieving the goal of the educational program is based on the principles of continuity and individualization of learning, fundamentality, and integrity of knowledge, practical orientation and awareness of the place of acquired competencies, the symbiosis of scientific and systematic approaches.
In the process of practical training is the formation and consolidation of general and special competencies, which are listed in the educational program.

**Types of classes and control**

In the process of internship, lectures, seminars, and excursions can be held, the topics of which are made taking into account the peculiarities of the specialty of training and the base of practice.

**Term**

Project (practice) – 6
Pre-graduation practice – 8

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| **Student workload (credits) / Type of course** | 6 / Mandatory | **Lectures (hours)** | - | **Laboratory classes (hours)** | - | **Self-study (hours)** | 360 |

**Program competences**

GC1. Ability to abstract thinking, analysis and synthesis.
GC2. Ability to apply knowledge in practical situations.
GC3. Knowledge and understanding of the subject area and understanding of professional activity.
GC6. Ability to learn and master modern knowledge.
GC7. Ability to search, process and analyze information from various sources.
GC8. Ability to generate new ideas (creativity).
GC9. Ability to work in team.
GC10. The ability to be critical and self-critical.
GC11. Ability to make justified decisions.

GC12. Ability to evaluate and ensure the quality of performed work.
GC13. Ability to act being based on ethical considerations.
GC14. Ability to implement personal rights and responsibilities as a member of society, to realize the values of civil (free democratic) society and the need for its sustainable development, the rule of law, human and civil rights, and freedoms in Ukraine.
GC15. Ability to preserve and multiply moral, cultural, scientific values and achievements of society based on understanding the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society, and in the development of society, techniques and technologies, active recreation and leading a healthy lifestyle.
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.
PC2. Ability to detect statistical patterns of non-deterministic phenomena, the use of computational intelligence methods, including statistical, neural network and fuzzy data processing, machine learning and genetic programming methods, etc.
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 unsolvability of algorithmic problems for adequate modelling of subject areas and creation of software and information systems.
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.
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.
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.
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.
PC8. Ability to design and develop software using different programming paradigms: generalized, object-oriented, functional, logical, with appropriate models, methods and algorithms of calculations, data structures and management mechanisms.
PC9. Ability to implement a multi-tier computing model based on the client-server architecture, including databases, knowledge bases, and data warehouses, perform distributed processing of large data sets on clusters of standard servers to meet the computing needs of users, including cloud services.
PC10. Ability to apply methodologies, technologies, and tools to manage the life cycle processes of information and software systems, information technology products and services according to customer requirements.
PC11. Ability to conduct intelligent data analysis based on methods of computational intelligence, including large and poorly structured data, their operational processing and visualization of analysis results in the process of solving applied problems.
PC12. Ability to ensure the organization of computational processes in information systems of various purposes, taking into account the architecture, configuration, performance indicators of operating systems and system software.
PC13. Ability to develop network software that operates based on different topologies of structured cable systems, uses computer systems and data networks, and analyzes the quality of computer networks.
PC14. Ability to apply methods and tools of information security, to develop and operate special software for security of information resources of critical information infrastructure.
PC15. Ability to analyze and perform functional modelling of business processes, construction and practical application of functional models of organizational, economic, and production-technical systems, methods of risk assessment of their design.
PC16. Ability to implement high-performance computing based on cloud services and technologies, parallel and distributed computing in the development

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| | and maintenance of distributed parallel information processing systems.<br>PC17. Ability to apply the theoretical and practical basics of modern management theory for complex organizational, technical and socio-economic systems to build intelligent management systems, in the process of designing intelligent systems to use modern information processing technologies and methods of computational intelligence.<br>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.<br>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.<br>PC20. Ability to develop the architecture of software systems and their particular components during the design of intelligent management systems in various fields, to manage the life cycle of intelligent management systems software. |

| Learning outcomes | Teaching and learning methods | Forms of assessment (continuous assessment CAS, final assessment FAS) |
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| 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.<br>PLO2. Use a modern mathematical apparatus of continuous and discrete analysis, linear algebra, analytical geometry, in professional activities to solve problems of theoretical and applied nature in the design and implementation of informatization objects.<br>PLO3. Use knowledge of the laws of random phenomena, their properties and operations with them, models of random processes, and modern software environments to solve problems of statistical data processing and construction of predictive models.<br>PLO4. Use methods of computational intelligence, machine learning, neural network, and fuzzy data processing, genetic and evolutionary programming to solve problems of recognition, prediction, classification, identification of management objects, etc.<br>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.<br>PLO7. Understand the principles of modelling organizational and technical systems and operations; use methods of operations research, solve single- and | 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) |

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.
PLO9. Develop software models of subject areas, choose a programming paradigm from the standpoint of convenience and quality of its application to implement methods and algorithms that solve problems in the computer science field.
PLO10. 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.
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).
PLO12. Apply methods and algorithms of computational intelligence and intelligent data analysis in the tasks of classification, prediction, cluster analysis, search for associative rules using software tools to support multidimensional data analysis based on technologies DataMining, TextMining, WebMining.
PLO13. Know the system programming languages and methods for the software development that interacts with the components of computer systems, know network technologies, computer network architectures, have practical skills in administration technology of computer networks and their software.
PLO14. Apply knowledge of methodology and CASE tools for designing complex systems, methods of structural analysis of systems, object-oriented design methodology in the development and study of functional models of

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| organizational-economic and production-technical systems.<br>PLO15. Understand the concept of information security, the principles of secure software design, ensure the security of computer networks in conditions of incomplete and uncertain input data.<br>PLO16. Perform parallel and distributed computations, apply numerical methods and algorithms for parallel structures, parallel programming languages in the development and operation of parallel and distributed software.<br>PLO17. Apply for the construction of intelligent management systems theoretical and practical foundations of modern management theory, design intelligent systems using modern information processing technologies and methods of computational intelligence.<br>PLO18. Apply modern methods of decision-making theory for the construction of intelligent management systems, including methods of ranking, formation, and coordination of collective expert assessments, multi-criteria optimization, and others.<br>PLO19. Create intelligent management systems using 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.<br>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. | | |
| **Structural and logical scheme of studying the discipline** | Before the practical training, students must have previously studied several disciplines. For project practice, there are SP1 - Algorithmization and programming, SP2 - Fundamentals of computer science and artificial intelligence methods, SP4 - Operating systems, SP5 - Algorithms and data structures, SP9 - Databases, SP10 - Object-oriented programming, SP12 - Fundamentals of web development, SP15 - Software architecture and design.<br>To conduct undergraduate practice, students must study the disciplines of general and special training in full. | |

## ASSESSMENT AND GRADING

| Ranges of points | core (points) for all types of learning activities | ECTS grading scale | The national grading scale | Allocation of grade points | At the end of the internship, students submit to the commission, which is approved by the head of the department, |
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| | 90-100 | A | excellent | | |

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| **corresponding to grades** | 82-89 | B | good | | a report and a diary of practice. Credit (with the differentiated assessment) is carried out following the Regulations on the procedure for practical training of higher education applicants of the National Technical University "Kharkiv Polytechnic Institute" (p. 6. Summarizing the practice). |
| | 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) | | |

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| **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. |

**THE CONTENT OF PRACTICAL TRAINING**

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| **Content** | During the internship, the student gets acquainted with the main forms of activity in his future specialty.<br>Practical training helps to increase students 'motivation to learn competencies, individualize learning, create conditions for the development of student's creative thinking, ability to generate new ideas, deepen and consolidate theoretical knowledge gained in higher education.<br>During the internship, students master new technologies of project development and implementation, acquire teamwork skills, improve communication skills in areas of professional activity. | **Self-study** | In the process of internship, students must:<br>- to get acquainted with perspective directions of development of intelligent systems;<br>- get acquainted with the standards and other regulatory documentation used in software development;<br>- perform the task using systematic and critical thinking;<br>- draw up the final documentation. |

**Academic integrity**

Students must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to show discipline, politeness, friendliness, honesty, responsibility

The content of this syllabus is consistent with the course program.