National Technical University of Ukraine
“Igor Sikorsky Kyiv Polytechnic Institute”

Faculty of Chemical Engineering

APPROVED

by the Methodical Council of
Igor Sikorsky Kyiv
Polytechnic Institute

minutes of meeting № 5
of 02/29/2024

F-catalogue

of professional training cycle elective academic disciplines

the first (bachelor) level of higher education
specialty
174 – Automation, Computer-Integrated Technologies and Robotics

professional educational programme

«AUTOMATION HARDWARE AND SOFTWARE»

edition for 2024/2025 academic year

Recommended:

by the Council of Faculty of
Chemical Engineering,

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INTRODUCTION

This catalogue contains a list and descriptions of academic disciplines that are recommended to be chosen by students studying at the first (bachelor) level of higher education in the professional educational programme «Automation Hardware and Software» specialty 174 – Automation, Computer-Integrated Technologies and Robotics.

The disciplines presented in this catalogue can also be chosen by students studying in other educational programs and specialties, provided they meet the requirements before starting to study these disciplines.

The catalogue is compiled by the graduate Automation Hardware and Software department based on the proposals of the department's lectures and lectures of other departments, which provide training of specialists according to the professional educational programme.

The number of disciplines that student can choose for the academic semester is determined by the curriculum. The disciplines chosen by the student are included in his individual study plan and become mandatory for study. It is not allowed to change elective disciplines after the end of the set selection periods. Taking into account the training peculiarities in the first level of higher education programs, the selection of disciplines according to this catalogue is carried out as follows:

- elective disciplines from this catalogue are not provided during the first and second year of bachelor's training;
- the second-year students choose elective disciplines that they plan to study in the third year, in particular:
    - four disciplines for the fifth academic semester;
    - four disciplines for the sixth academic semester;
- the third-year students choose elective disciplines that they plan to study in the fourth year, in particular:
    - two disciplines for the seventh academic semester;
    - four disciplines for the eighth academic semester;

The disciplines choice is carried out using an automated system for organizing the educational process in university.

Elective disciplines are available for selection from the fifth semester

Infographics and Data Visualisation	
Educational level	First (Bachelor)
Course, semester	3rd course, 5th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software department
Assumed knowledge and prerequisites	Mastering the regulatory basic knowledge of information technology, in particular, skills in using general-purpose software.
Scope of the course	Study theoretical and practical issues related to the interpretation of data analysis results and their visualisation based on the use of modern infographic methods and tools.
Rationale	Data visualisation is increasingly being used as a crucial component in scientific research, data mining, process research, production control, etc. Information visualisation is aimed at creating new and more visual approaches to communicating abstract information in intuitive ways. One of the most pressing tasks today is the processing and analysis of large volumes of structured and unstructured data to improve the quality of decisions. Data analysis is an integral part of all applied research, including solving problems in process control.
Learning outcomes	Expected learning outcomes include: – describe the use of data visualizations to talk about data and the results of data analysis; – identify PowerBI, Canva, Visme etc. as data visualization tools and understand theirs use; – explain what data driven stories are including reference to their importance and their attribute; explain principles and practices associated with effective presentations.
Competencies and skills	Upon successful completion of the course students are expected to be able on the base of knowledge of visualisation of research results, to present the necessary information for their analysis and further use, in particular when making decisions on process control.
Instructional Materials	syllabus, textbooks (electronic editions), training stands, simulation software.
Delivery mode	lectures, seminars, practical
End-of-semester control	final test

Mathematical Software and Their Applications	
Educational level	First (Bachelor)
Course, semester	3rd course, 5th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and software department
Assumed knowledge and prerequisites	Basic knowledge of mathematics, numerical methods and programming.
Scope of the course	The capabilities of mathematical packages Mathcad, MATLAB and Comsol cover a variety of problems in mathematical analysis, linear algebra, differential calculus, mathematical physics, etc. The ability to perform symbolic calculations and visualize the results of applied problems.
Rationale	A bachelor acquires knowledge and a tool for solving many tasks while studying many subjects, especially when performing home control and calculation works and further when completing a bachelor's project. Performing applied tasks in classes provides an opportunity to use the built-in tools of the Mathcad, MATLAB, and Comsol software environments without creating programs for complex calculations.
Learning outcomes	Expected learning outcomes include: – capabilities of both numerical and symbolic calculations in these packages. how to implement the solution of equations and systems of algebraic, ordinary differential, and partial differential equations, which are used in the modelling of technological processes
Competencies and skills	Upon successful completion of the course, students are expected to be able to: – use a variety of specialized software for solving typical engineering problems in the field of automation, – mathematical modelling, automated design, database management, computer graphics methods
Instructional Materials	syllabus, textbooks (electronic editions), simulation software
Delivery mode	lectures, practical
End-of-semester control	First (Bachelor)

Software Development Technologies	
Educational level	First (Bachelor)
Course, semester	3rd course, 5th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software department
Assumed knowledge and prerequisites	– programming basics (variables and functions); – principles of Object-Oriented Programming; client-server architecture and relational databases.
Scope of the course	Methods and technologies used in the software development lifecycle: version control systems, design patterns, software testing, deployment.
Rationale	Modern software has a specific lifecycle, characterized by design, development, testing, and deployment stages. Each of these stages affects the speed of creating a software product and its characteristics. Knowledge of the methods and tools used at each stage allows the development team to work on the project in parallel and get a high-quality and reliable software product.
Learning outcomes	Expected learning outcomes include: – version control systems and repository usage; – design patterns (**creational, structural, behavioural**); – principles for writing quality code (SOLID); – software testing techniques; – DevOps basics; development of telegram bots.
Competencies and skills	Upon successful completion of the course students are expected to be able to: – create software for technological and business process management systems programmatically implement the user interface and server layer, perform software testing and deployment.
Instructional Materials	syllabus, textbooks (electronic editions) IDE - environments. Software: git version control system, DBMS, frameworks for unit, integration and load testing.
Delivery mode	lectures, practical (computer workshop)
End-of-semester control	final test

Industrial Data Transmission Networks	
Educational level	First (Bachelor)
Course, semester	3rd course, 5th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software department
Assumed knowledge and prerequisites	Mastering the regulatory disciplines “Electrical engineering”, "Automation Hardware", "Information Systems Design", "Automation Systems Design"
Scope of the course	Organization of data exchange industrial networks, standard interfaces and protocols for such network, industrial networks integration technologies.
Rationale	During the rapidly growing use of microprocessor control devices, industrial data transmission networks have become an effective solution. The information flows between the components of industrial equipment, in particular complex automation industrial systems, individual personal computers, programmable logic controllers, encoders, executive mechanisms, in distributed control systems, is implemented with the help of optimally designed and implemented communication channels, that is, through complex using the industrial network technologies.
Learning outcomes	Expected learning outcomes include: – industrial network technologies and types, – industrial networks interfaces (current loop, RS-232, RS-485), – industrial networks protocols (HART, ModBus, ProfiBus, industrial Ethernet); integration technologies (OPC Classic, OPC UA).
Competencies and skills	Upon successful completion of the course students are expected to be able to: – design the industrial data networks; debug and configure devices in industrial networks.
Instructional Materials	syllabus, textbooks (electronic editions), training stands, simulation software.
Delivery mode	lectures, seminars, practical
End-of-semester control	final test

Special Mathematical Methods	
Educational level	First (Bachelor)
Course, semester	3rd course, 5th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software department
Assumed knowledge and prerequisites	Students need to have the knowledge and skills provided by the discipline "Higher Mathematics", mastering the disciplines in programming,.
Scope of the course	The main trends and directions of development of the theory of graphs, matrices, differential equations for functions of one and many variables. Special mathematical methods of graph theory of complex objects and systems of various nature.
Rationale	The acquired knowledge and skills will make it possible to effectively use existing methods to solve complex problems of automatic control and decision-making, regularities in the data structures of various objects in the field of modelling and synthesis of automated control systems.
Learning outcomes	Based on the results of studying the material of the discipline, students will acquire solid knowledge of linear and vector algebra, discrete mathematics, experience in solving various professional problems, special mathematical methods of complex objects and systems of various nature, research and modelling of objects and control systems using graph theory algorithms.
Competencies and skills	Upon successful completion of the course students are expected to be able to: – apply modern methods of graph theory of complex objects and automation systems. Master new methods of analysis and synthesis of automated object management systems for various purposes; – to perform the analysis of automation objects based on knowledge about the processes taking place in them, applying the methods of graph theory and linear algebra for research. use modern computer technologies aimed at solving scientific and technical problems of system analysis and management in the field of automation of complex objects and systems.
Instructional Materials	syllabus, textbooks (electronic editions), simulation software.
Delivery mode	lectures, computer workshop
End-of-semester control	final test

Control Objects in Chemical Technology	
Educational level	First (bachelor's)
Course, semester	3rd course, 5th semester
Credits	4 ECTS
Teaching language	Ukrainian
Teaching department	Inorganic Substances Technology, Water Treatment and General Chemical Technology
Assumed knowledge and prerequisites	Basic knowledge of general and inorganic, organic and physical chemistry
Scope of the course	Chemical and technological processes (CTP): classification, CTP indicators, efficiency criteria, equilibrium and ways to shift it towards the formation of target products. Raw materials in chemical technology and methods of their enrichment. Industrial water purification and water treatment. Energy of chemical enterprises and methods of energy saving and energy efficiency. Waste from chemical processing plants. Examples of real manufactures.
Rationale	Modelling and automation of industrial processes requires an understanding of the processes and factors that influence the course of these processes and the features of the equipment on which these processes are implemented. This discipline is designed for engineers, provides in-depth knowledge of the basic laws of chemical technology, technological schemes used in the chemical industry for the production of industrially important substances, and their implementation technology, which is very important for acquiring skills in chemical process management.
Learning outcomes	As a result of studying this discipline, students acquire knowledge of: - basic issues of chemical production as a technological system and hierarchical organisation of the process; - basic criteria for evaluating chemical technologies; classification of chemical and technological processes; - technologies and equipment of the most important industrial processes, as well as progressive measures to improve the environmental friendliness of technologies, quality and consumer characteristics of products.
Competencies and skills	The acquired knowledge and skills will allow solving technological and environmental problems in production conditions, competently operating chemical and auxiliary equipment, effectively solving problems of automation and control of technological processes in order to maintain and, if necessary, change technological modes. In addition, the acquired knowledge will allow you to choose the right direction of change in technological parameters (concentration, pressure, catalyst) based on the main indicators of the kinetics of chemical and technological processes. The main achievement will be the conscious use of measuring instruments to control chemical and technological processes.
Instructional Materials	Syllabus, Presentations, Lecture materials, Laboratory guidelines
Delivery mode	Lectures and laboratory work
End-of-semester control	final test

Control Objects in Plant Polymer Technology	
Educational level	First (bachelor's)
Course, semester	3rd course, 5th semester
Credits	4 ECTS
Teaching language	Ukrainian
Teaching department	Ecology and technology of plant polymers
Assumed knowledge and prerequisites	Basic knowledge of chemistry, general ecology, and chemical production processes and equipment
Scope of the course	– Characteristics of plant raw materials used for the production of fibrous semi-finished products, qualitative characteristics of fibrous semi-finished products; – Main technological processes for obtaining fibrous semi-finished products for the production of paper and cardboard; – Classification, properties, and applications of various types of cardboard and paper products; Main technological processes of paper production.
Rationale	The invention of paper production by the Chinese inventor Cai Lun in 105 AD is one of the most significant achievements of humanity. Today, it is impossible to imagine any area of human life without paper and paper products, and the level of economic development and societal well-being is often assessed based on per capita paper consumption. Despite the advancement of modern technologies, where electronic information carriers are gradually replacing paper, and the emergence of new types of synthetic packaging, paper production continues to grow steadily. This growth is driven by the increasing global population and economic development, which contributes to improving people's quality of life. Paper production is a complex, multi-stage, continuous process that uses plant fiber semi-finished products as raw materials and requires significant amounts of water and energy. The technological processes involved in paper production have a substantial impact on the environment. The complexity of these processes necessitates advanced control and management systems.
Learning outcomes	The main processes and technological parameters of pulp and paper production
Competencies and skills	Using knowledge of the technology, develop automation, control, and management systems for the technological processes of pulp and paper production to enhance its reliability.
Instructional Materials	Syllabus, study guides
Delivery mode	Lectures, practical classes
End-of-semester control	final test

Data Exchange Networks	
Educational level	First (Bachelor)
Course, semester	3rd course, 5th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software Department
Assumed knowledge and prerequisites	Mastering the normative disciplines "Fundamentals of information and of communication technologies", "Programming", "Design of systems automation".
Scope of the course	Organization of local and global networks of general purpose, organization of industrial networks.
Rationale	In connection with the widespread use of modern computer networks in various areas of human activity, the problem of local and global organization networks is very important. Computer data networks are the result evolution of computer technology and currently form the main means communication the creation of computer networks is caused by the need for common using information on devices remote from each other, such as traditional computers, as well as industrial computers, servers, controllers.
Learning outcomes	In the process of studying the course, the student will gain knowledge of modern construction computer networks; local network standards and channel protocols equal; knowledge of the organization of networks of the ETHERNET family, networks (technology) FDDI and Fast Ethernet, generalized structure and communication subsystems global networks and global networks with packet switching.
Competencies and skills	The ability to create local and global networks is a prerequisite remote management of processes, searching for information on the network and working with modern enterprise automation systems.
Instructional Materials	syllabus, textbooks (electronic editions), training stands, simulation software.
Delivery mode	lectures, practical (computer workshop)
End-of-semester control	final test

Pneumatic Automation Systems and Facilities	
Educational level	First (Bachelor)
Course, semester	3rd course, 5th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software department
Assumed knowledge and prerequisites	Mastering the normative disciplines "Physics", "Theoretical Mechanics", "Electrical Engineering", "Technological Measurements and Devices", "Automation Tools", "Design of Automation Systems"
Scope of the course	Mastering the methods of creation and operation of pneumatic automation systems.
Rationale	Some of the leading branches of the national economy are chemical, petrochemical, electrical, energy, glass, food, cement, metallurgical, etc. Carrying out technological processes in these sectors of the national economy is impossible without the use of automation equipment that is fire and explosion-proof. Such means are pneumatic automatics. Therefore, employees involved in the design, development and operation of automated control systems must correctly select and use the appropriate automation tools in compliance with the appropriate safety rules and the rules for their combination. It is also very important to be able to read correctly and create new pneumatic schematic diagrams. One of the very important tasks is the task of combining other means of automation with pneumatic actuators, in which pneumatic automation means act as intermediate links. This discipline is devoted to the study of these issues.
Learning outcomes	As a result of training, the student will master the methods of creating and operating pneumatic automation systems and pneumatic regulators and devices.
Competencies and skills	Upon successful completion of the course, students are expected to be able to: - gain knowledge and experience in the creation, installation and operation of pneumatic automation systems; - ability to work with technical literature, standards, pneumatic automation equipment, regulators, specialized technological equipment and other regulatory documents; - mastering the methods of creation and operation of pneumatic automation systems.
Instructional Materials	Syllabus, textbooks (electronic editions), training stands, software for modeling pneumatic control systems.
Delivery mode	Lectures, seminars, practical classes, laboratory work.
End-of-semester control	Final test

Theoretical Foundations of Heating Technology	
Educational level	Basic (bachelor)
Course, semester	Year 3, semester 5
Credits	4 credits ЄКТС (120 academic hours: 54 hr. lectures, 66 hr. Individual tasks)
Teaching language	Ukrainian
Teaching department	Chemical, Polymer and Silicate Engineering Department
Assumed knowledge and prerequisites	Mathematics, Physics, Chemistry
Scope of the course	Heat engineering is based on thermodynamics fundamentals that deals with the heat flows and their transfer. Mostly in industry processes we investigate the energy conversation during the technology processes. Energy is transferred between two or more mediums or transformed into other forms of energy. An engineer must have knowledge of thermodynamics and the process of converting energy from energy sources into chemical, mechanical, or electrical energy. In industry a wide variety of equipment is used that utilize heat transfer in some way.
Rationale	Heat Engineering is based on Thermodynamics Laws aiming to apply them in technology processes. Training in Heat Engineering enables to get the knowledge of Thermodynamics fundamentals and conversion regularities of heat and capacity.
Learning outcomes	Getting the knowledge of Thermodynamics fundamentals, abilities of analysis the heat engines, technology equipment and processes. Getting the skills of heat resource saving.
Competencies and skills	Subject makes an ability of Thermodynamics fundamentals using on computing and energy efficiency processes analysis.
Instructional Materials	Syllabus, training guide
Delivery mode	Lectures, practice classes
End-of-semester control	Final test

Experimental Research of Technological Objects	
Educational level	First (Bachelor)
Course, semester	3nd course, 5th semester
Credits	4 ECTS credits (120 academic hours: 54 classroom hours, 66 hours of self-study)
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software department
Assumed knowledge and prerequisites	Basic knowledge of mathematics, probability theory, mathematical statistics, modelling and identification, automatic control theory, technical means of automation, and physicochemical fundamentals of technological processes
Scope of the course	Modes of operation of technological objects (TO), research methods, organization of experiments in laboratory and production conditions, planning experiments to obtain models of static and dynamic modes of TO, methods for processing experimental data, and software tools for identification.
Rationale	Models of technological objects allow for the exploration of control algorithms, comparison of alternative control system options, determination of optimal settings for regulators and operational parameters and prediction of object behaviour. Models that solve these tasks should reflect the object's properties. A properly conducted experiment allows for the identification of such properties.
Learning outcomes	- be able to conduct analysis of automation objects and justify the choice of structure, algorithms, and control schemes based on the study of their properties; - be able to apply methods of system analysis, identification, and numerical methods to develop mathematical and simulation models of individual elements and automation systems as a whole; be able to perform technological measurements and process and interpret their results.
Competencies and skills	- analyse automation objects based on knowledge of processes occurring in them and apply methods of automatic control theory for the study of objects and automatic control systems; conduct measurements of a wide range of technological parameters of automation objects, and perform processing of measurement results based on mathematical statistics and data analysis methods.
Instructional Materials	Syllabus, manuals
Delivery mode	Lectures and practical classes
End-of-semester control	Final test

Mechanical Principles of Robotics	
Educational level	First (Bachelor)
Course, semester	3nd course, 5th semester
Credits	4 ECTS credits (120 academic hours: 54 classroom hours, 66 hours of self-study)
Teaching language	Ukrainian
Teaching department	Construction of machines
Assumed knowledge and prerequisites	Successful mastering of the knowledge and skills acquired during the study of the disciplines “Physics” and "Robotics"
Scope of the course	Mechanical objects (mechanisms, machines), as complex multi-mass systems of bodies, which are created and function according to certain structural, kinematic and force laws of interaction, both of individual masses with each other, and of the system as a whole with the working environment; research (structural, kinematic and dynamic) of existing and development of new mechanisms with optimal structural, kinematic and dynamic parameters; carry out calculations and construction of individual parts and their formations (assemblies), the materials, shape and dimensions of which optimally satisfy the criteria of their operability and reliability in the specified operating conditions
Rationale	The acquired knowledge and skills during the course lay a professional basis for student training, contribute to the acquisition of theoretical knowledge and practical skills of structural, kinematic and dynamic analysis and synthesis of mechanisms; calculations of kinematic and energy parameters
Learning outcomes	To study the general design, principle of operation, application and basis of selection of typical parts and assemblies of machines; master the skills and abilities of designing and calculating original designs of machine parts and assemblies.
Competencies and skills	To solve practical problems on the design and calculations of parts, mechanisms and machines of various purposes. Develop basic design schemes and working drawings of mechanisms, assemblies and parts of machines; develop technical documentation for products.
Instructional Materials	Syllabus, study aids
Delivery mode	Lectures, computer workshop
End-of-semester control	Final test

Elective disciplines are available for selection from the sixth semester

Parametric Modelling of Technological Processes	
Educational level	First (Bachelor)
Course, semester	3rd course, 6th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and software department
Assumed knowledge and prerequisites	Mastery of 'Computer Graphics' and 'Computer Modelling of Processes and Systems'. Understand heat and mass transfer processes and technological solutions.
Scope of the course	Principles of designing three-dimensional objects and modelling processes.
Rationale	Modelling is essential when studying complex processes or systems. A model is usually more accessible for research than a real object. The traditional methodology of the relationship between theory and experiment should be complemented by the principles of computational modelling. This powerful technique allows a holistic study of the behaviour of the most complex systems, both natural and those created to test theoretical hypotheses. Computational modelling is a method of solving the problem of analysing or synthesising a complex system by using its computer model. The essence of computational modelling is to find quantitative and qualitative results using an existing model. All this points to the importance of studying parametric modelling methods and their rational application in solving specific problems.
Learning outcomes	During the course, the student will acquire knowledge of the following features of parametric modelling of technological processes and objects. As a result of the course the student will learn to: (1) Develop models of real objects; (2) Calculate the parameters of physical processes using finite element methods; (3) Calculate spatially stationary and unsteady flows of liquids and gases, laminar and turbulent flows, flows in porous media, convective, radiative heat transfer and heat conduction, movement of the dispersed phase in the carrier flow (solid particles, drops); (4) Use modern software tools in the implementation of models.
Competencies and skills	The creation of models of technological objects, computer modelling of physical processes and visualisation of the results obtained allows us to study technological processes without conducting full-scale experiments.
Instructional Materials	Syllabus, textbooks (electronic editions), computer modelling software tools.
Delivery mode	lectures, practical
End-of-semester control	Final test

Information Technologies of Data Analysis	
Educational level	First (Bachelor)
Course, semester	3rd course, 6th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and software department
Assumed knowledge and prerequisites	Basic mathematics, statistics, object and system modelling.
Scope of the course	The role and place of data analysis in information systems. Mathematical methods and algorithmic approaches to the acquisition, transformation, visualization and processing of data in organizational, technical, natural and socio-economic systems.
Rationale	In the context of a significant increase in the amount of information and the emergence of the concept of 'big data', the task of computer processing this data for decision making is relevant - searching for hidden patterns using classification, regression, clustering and time series methods.
Learning outcomes	During the course, students will gain knowledge of - The structure of decision support systems; - Data analysis tasks: classification, regression, clustering, search associative rules; - Cognitive technologies of data analysis; - Statistical methods of data analysis; - Information technologies for data analysis;
Competencies and skills	Solve problems related to the design of information systems mathematical modelling of objects, forecasting the parameters of processes and phenomena for decision-making, using software for data analysis.
Instructional Materials	syllabus, textbooks (electronic editions), data analysis software
Delivery mode	lectures, practical
End-of-semester control	Final test

Chemical Production Equipment	
Educational level	First (Bachelor)
Course, semester	3rd course, 6th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Department of Chemical Engineering and Oil Refining Industry
Assumed knowledge and prerequisites	The course belongs to the cycle of electives and is based on the knowledge of the following disciplines: "Higher Mathematics", "Physics", "Engineering and Computer Graphics".
Scope of the course	Basic knowledge of various types of chemical and technological processes and their classification, areas of process automation, design features of apparatus and machines for the implementation of these processes, the principle of operation, their comparative characteristics, advantages and disadvantages. Equipment for hydromechanical, heat exchange, mass transfer, mechanical processes, high pressure apparatus, etc. will be considered.
Rationale	Chemical production equipment is a mandatory component of the vast majority of production lines in the chemical industry and related industries (food, pharmaceutical, oil refining, etc.), and in many cases the operation of the relevant equipment significantly affects the efficiency of the plant as a whole. An effective automation system cannot be developed without knowing the design and parameters of the automation object. Therefore, knowledge of the basic principles, mechanisms and hardware implementation of typical hydromechanical, mechanical, heat and mass transfer processes, as well as their automation is an important component of training specialists in the field of modern technologies, software, and automated control.
Learning outcomes	Expected learning outcomes include: – basic information about hydromechanical, heat exchange, mass transfer, mechanical processes, their types and classification; – standard designs of elements, parts and assemblies of machines and apparatus, their classification, scope of application; knowledge of the design and principles of operation, advantages, disadvantages and comparative characteristics of chemical production equipment as automation objects.
Competencies and skills	Ability to apply the acquired knowledge to solve theoretical and applied problems: – in the design or operation of automation equipment at enterprises of chemical, pharmaceutical, food and other industries; in the development of automation systems for chemical and technological processes and production.
Instructional Materials	syllabus, textbooks (electronic editions), presentations and demonstration videos
Delivery mode	lectures, practical
End-of-semester control	Final test

Fundamentals of Designing Computer-Integrated Technological Complexes	
Educational level	First (Bachelor)
Course, semester	3rd course, 6th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software Department
Assumed knowledge and prerequisites	Completion of educational component “Fundamental Information and Communication Technologies”, “Programming”, “Automation Systems Design” or compatible
Scope of the course	The course covers the fundamentals of modern automated control systems and other computer-integrated systems for industrial and non-industrial purposes
Rationale	The educational component promotes the development of professional experience in LabVIEW environment and interactive analysis, dataflow programming, and common development techniques. In this course, you will learn how to develop data acquisition, instrument control, data-logging, and measurement analysis applications.
Learning outcomes	Expected learning outcomes include being able to: – create user interfaces with charts, graphs and buttons; – use programming structures, data types and the analysis and signal processing algorithms in LabVIEW; – debug and troubleshoot applications; – log data to file; use best programming practices for code reuse and readability
Competencies and skills	Upon successful completion of the course students are expected to be able to create and program a LabVIEW application that acquires, analyses and visualizes data
Instructional Materials	syllabus, textbook, training equipment
Delivery mode	lectures, seminars, practical
End-of-semester control	final test

Algorithms and Data Structures	
Educational level	First (Bachelor)
Course, semester	3rd course, 6th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and software department
Assumed knowledge and prerequisites	Mastering the regulatory disciplines "Fundamentals of programming", "Object-oriented programming", "Technologies of software development"
Scope of the course	Consider various implementations of abstract data types, ranging from arrays, linear lists, stacks, queues, binary trees, to sets and graphs, which are used to informally describe and implement algorithms. Study of sorting algorithms and quick search of an element by a given key, recursion, tree search, etc. Analysis of the complexity of algorithms. Software implementation of the considered algorithms.
Rationale	The acquired knowledge can be used for software implementation of classical algorithms; every effective program needs the ability to assess the theoretical complexity of algorithms; will allow you to acquire skills in solving practical tasks of professional activity in the construction of complex software.
Learning outcomes	Expected learning outcomes include: - basic data structures used in software development - standard algorithms and characteristics of their complexity for typical problems; basic methods of solving problems, such as sorting and quick searching.
Competencies and skills	Upon successful completion of the course students are expected to be able to: - choose appropriate data structures when developing complex software projects - to find algorithmic and software solutions in the area system and application programming, use the most effective algorithms when creating mathematical, information and simulation models
Instructional Materials	syllabus, textbooks (electronic editions), simulation software
Delivery mode	lectures, practical
End-of-semester control	final test

Pulp and Paper Production Equipment	
Educational level	First (undergraduate)
Course, semester	Course 3, semester 6
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Machines and devices of chemical and oil refining industries
Assumed knowledge and prerequisites	The discipline belongs to the elective cycle and is based on the knowledge of the following disciplines: "Higher mathematics", "Physics", "Engineering and computer graphics".
Scope of the course	Basic knowledge of various types of processes of pulp and paper production and their classification, directions of automation of processes, features of designs of devices and machines for the implementation of these processes, the principle of operation, their comparative characteristics, advantages and disadvantages. Equipment for pulp and paper production processes will be considered.
Rationale	The equipment of pulp and paper production is an important part of production in Ukraine, knowledge of these processes will allow to argue effective automation systems. Therefore, knowledge of the basic principles, mechanisms and hardware implementation of typical processes of pulp and paper production, directions of their automation is an important component of training specialists in the field of modern technologies, software, and automated control.
Learning outcomes	- basic information about pulp and paper production processes; - typical designs of elements, parts and assemblies of machines and devices, their classification, areas of application; - knowledge of constructions and principles of operation, advantages, disadvantages and comparative characteristics of chemical production equipment as objects of automation.
Competencies and skills	The ability to apply the acquired knowledge to solve theoretical and applied problems: when designing or operating automation equipment at chemical, pharmaceutical, food and other industries; in the development of process automation systems and apparatus for pulp and paper production.
Instructional Materials	Syllabus, tutorials, presentations and demonstration videos
Delivery mode	Lectures, practical classes
End-of-semester control	Final test

Specialized Tasks of System Analysis	
Educational level	First (Bachelor)
Course, semester	3rd course, 6th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software department
Assumed knowledge and prerequisites	Mastering the disciplines in programming, numerical methods, mathematical modelling and automatic control theory.
Scope of the course	The discipline considers the basic concepts of definition, provisions and mathematical methods of system analysis for research and modelling of technological objects and control systems.
Rationale	The creation of effective and reliable computer automation systems is impossible without appropriate mathematical support for their work, understanding of the essence of regularities of processes occurring in control objects, the main trends and directions of development of system analysis, decision-making and experience in solving various professional problems by special mathematical methods and procedures of system analysis of complex objects and systems of various nature, research and modelling of objects and control systems based on the results of the study of their properties
Learning outcomes	Expected learning outcomes include the ability to apply methods of system analysis, modelling, identification and numerical methods to develop mathematical and simulation models of individual elements and automation systems as a whole, to analyse the quality of their functioning using the latest computer technologies.
Competencies and skills	Upon successful completion of the course students are expected to be able to apply methods of system analysis, mathematical modelling, identification, and numerical methods to develop mathematical models of individual elements and automation systems as a whole.
Instructional Materials	syllabus, textbooks (electronic editions), simulation software.
Delivery mode	lectures, seminars, practical
End-of-semester control	final test

Integrated Automated Control Systems	
Educational level	First (Bachelor)
Course, semester	3rd course, 6th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and software department
Assumed knowledge and prerequisites	Mastering the regulatory disciplines “Electrical engineering”, "Automation Hardware", "Information Systems Design", "Industrial data transmission networks".
Scope of the course	Design methodology of integrated automated control systems, hierarchical levels of decision-making at the enterprise in the conditions of operation of IACS, technologies for development of types of IACS support.
Rationale	At present, even in the conditions of automation of the work of modern enterprises, it is often not possible to develop a unified production management system, and the effect of automation is low. This is due to the post-task approach in the development of automation systems. The systematic approach to the design of IACS involves the development of IACS based on a five-level pyramid of complex production automation, which takes into account the hierarchical levels of decision-making in a modern enterprise. IACS is implemented by components of types of security through an integrated base, which is developed as a single one for all automation subsystems with a minimum of redundancy. This will make it possible to make informed decisions on the basis of timely and reliable information about the flow of technological processes, about the state of production, about the strategic tasks of the enterprise. The PostgreSQL DBMS is recommended for the operation of the IACS database based on the method of expert evaluations, the capabilities of which are studied in practical classes.
Learning outcomes	Expected learning outcomes include: – technology for the development of methodical support of IACS, – IACS information support development technology, – IACS software development technology, – IACS technical support development technology, – technology of development of organizational support of IACS, basic operators of the SQL query language of the PostgreSQL DBMS.
Competencies and skills	Upon successful completion of the course students are expected to be able to: – design types of IACS facilities, use the SQL query language of the PostgreSQL DBMS when solving practical tasks of automating modern enterprises.
Instructional Materials	syllabus, textbooks, manuals (electronic editions), simulation software.
Delivery mode	lectures, seminars, practical.
End-of-semester control	final test

Means and Methods of Control Systems Mounting	
Educational level	First (Bachelor)
Course, semester	3rd course, 6th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software department
Assumed knowledge and prerequisites	Mastering the normative disciplines "Physics", "Theoretical Mechanics", "Electrical Engineering", "Technological Measurements and Devices", "Automation Tools", "Design of Automation Systems","Information Systems Design".
Scope of the course	The purpose of this discipline is to develop students' knowledge and experience in the creation, installation and operation of automation systems.
Rationale	In modern conditions, it is impossible to create a new technological process without appropriate technical documentation, new technological equipment, modern technical means of automation and compliance with the appropriate rules for the installation of these automation equipment. Therefore, employees involved in the design, development and operation of automated control systems must correctly use the existing technical documentation, create new technical documentation, select appropriate switchboard equipment, electrical, pneumatic and hydraulic power sources in compliance with the relevant safety rules and communication rules, choose modern monitoring and management tools. It is also very important to be able to correctly read and create new functional automation diagrams, electrical and pneumatic schematic diagrams, wiring and switching diagrams, external connection diagrams, etc. In the context of constant production renewal, it is very important to correctly use digital devices, personal computers, programmable logic controllers, the exchange between which is carried out digitally using optimized communication channels. This discipline is devoted to the study of these issues.
Learning outcomes	In the process of studying the discipline, the student will master the methods of creating and operating automation systems. During their studies, students acquire the ability to work with technical documentation, standards, technical means of measurement and automation, technological equipment, regulatory documents, safety rules.
Competencies and skills	Upon completion of the training, students will master the methods of creating and operating automation systems.
Instructional Materials	syllabus, textbooks, textbooks (electronic editions), training stands, software for device research and automation modeling.
Delivery mode	lectures, seminars, practical classes, laboratory classes.
End-of-semester control	Final test

Machine Vision Basics	
Educational level	First (Bachelor)
Course, semester	3rd course, 6th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and software department
Assumed knowledge and prerequisites	Mastering the regulatory disciplines “Electrical engineering”, "Automation Hardware", "Information Systems Design", "Automation Systems Design"
Scope of the course	The scope of this course covers the fundamental concepts, tools, and techniques related to how machines, especially computers and robots, perceive and interpret visual information.
Rationale	This course equips students with the theoretical knowledge and practical skills necessary to excel in industries driven by automation, AI, and robotics. The course not only prepares them for current technologies but also positions them to thrive in a future where visual data processing will be an even more critical aspect of intelligent systems and smart environments.
Learning outcomes	Expected learning outcomes include: – Understanding the Fundamentals of Machine Vision – Image Acquisition and Processing – Feature Extraction and Object Recognition – 3D Vision and Depth Estimation Geometric Transformations and Camera Calibration
Competencies and skills	Upon successful completion of the course students are expected to be able to: – Competency in using cameras and image sensors: Understand different types of cameras, optics, and lighting setups. – Image processing skills: Apply digital image processing techniques – Feature extraction techniques: Implement algorithms to detect key points, edges, and shapes in images, such as SIFT, SURF, or ORB. – Object recognition and classification: Use machine learning models and pattern recognition techniques to identify and classify objects within images. – Competency in template matching for recognizing patterns in industrial automation and inspection systems. – Stereo vision and depth mapping: Develop systems that extract 3D information from 2D images using stereo vision techniques or depth-sensing technologies. Point cloud processing: Work with 3D point clouds to reconstruct environments or objects in industrial applications.
Instructional Materials	syllabus, textbooks (electronic editions), training stands, simulation software/
Delivery mode	lectures, seminars, practical
End-of-semester control	final test

Educational level	
Course, semester	
Credits	
Teaching language	
Teaching department	
Assumed knowledge and prerequisites	
Scope of the course	
Rationale	
Learning outcomes	
Competencies and skills	
Instructional Materials	
Delivery mode	
End-of-semester control	

Educational level	
Course, semester	
Credits	
Teaching language	
Teaching department	
Assumed knowledge and prerequisites	
Scope of the course	
Rationale	
Learning outcomes	
Competencies and skills	
Instructional Materials	
Delivery mode	
End-of-semester control	

Elective disciplines are available for selection from the seventh semester

Optimization Methods and the Basis of Finding Optimal Solutions	
Chair	Automation Hardware and Software
VO level	first (*Bachelor*))
Course	4th year, 7th semester
Amount	4 ECTS credits (120 hours: 54 hours of classroom work, 66 hours of SRS)
Language of teaching	Ukrainian
Requirements for starting studies	Knowledge of process technology, mathematical modeling, theory of automatic control.
What will be studied	Construction of economic models based on the statement of the problem, goal, criteria, restrictions for solving optimization problems on the basis of modern optimization methods.
Why is it interesting/should be studied?	The acquired knowledge and skills will allow you to create, program, configure and safely operate optimization models for practical implementation
Why you can learn(study results)	▪ apply knowledge of applied mathematics, optimization theory to the extent necessary for solving typical optimization problems.; ▪ know the principles of choosing a strategy for finding the optimal solution, which allows you to solve many management and organizational problems in an optimal way; ▪ perform static optimization tasks that ensure the maximum utility of the object or process.
How to use acquired knowledge and skills (competencies)	▪ apply knowledge of mathematics to the extent necessary for the use of mathematical methods for the analysis and synthesis of automation systems; ▪ perform analysis of automation objects based on knowledge of the processes taking place in them and apply methods of automatic control theory for research, analysis and synthesis of automatic control systems; ▪ apply the methods of system analysis, mathematical modelling, identification and numerical methods to develop mathematical models of individual elements and automation systems as a whole, to analyse the quality of their functioning using the latest computer technologies.
Information support	Syllabus, study aids
The form of classes	Lectures, computer workshop
Semester control	Test

Operations Research in Control Systems	
Chair	Automation Hardware and Software
VO level	first (*Bachelor*)
Course	4th year, 7th semester
Amount	4 ECTS credits (120 hours: 54 hours of classroom work, 66 hours of SRS)
Language of teaching	Ukrainian
Requirements for starting studies	Knowledge of technical means of automation, electronics and microprocessor technology.
What will be studied	Construction of the upper level of automated control systems for technological processes based on modern optimization methods to increase quality, productivity, and reduce energy consumption of systems.
Why is it interesting/should be studied?	The acquired knowledge and skills in operations research will allow you to create, program, configure and safely operate extreme control systems.
Why you can learn(study results)	▪ apply knowledge of applied mathematics, optimal control theory to the extent necessary for systematic analysis of purposeful actions and comparison of possible results of these actions; ▪ to know the principles of choosing and using modern methods and software tools for solving operations research problems; ▪ perform static optimization tasks taking into account typical operations research tasks.
How to use acquired knowledge and skills (competencies)	▪ apply knowledge of mathematics to the extent necessary for the use of mathematical methods for the analysis and synthesis of automation systems; ▪ perform analysis of automation objects based on knowledge of the processes taking place in them and apply methods of automatic control theory for research, analysis and synthesis of automatic control systems; ▪ apply the methods of system analysis, mathematical modeling, identification and numerical methods to develop mathematical models of individual elements and automation systems as a whole, to analyze the quality of their functioning using the latest computer technologies.
Information support	Syllabus, study aids
The form of classes	Lectures, computer workshop
Semester control	Test

Software for Modelling Control Systems	
Educational level	First (Bachelor)
Course, semester	4th year, 7th semester
Credits	4 ECTS credits / 120 academic hours
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software
Assumed knowledge and prerequisites	Basic knowledge of programming, numerical methods, mathematical modelling, and automatic control theory.
Scope of the course	Software tools for applied mathematics for identification, analysis, modelling and synthesis of control systems with linear stationary objects.
Rationale	This course allows you to creatively use specialized software to solve typical problems in the field of automation, in particular, mathematical modelling of dynamic objects and control systems.
Learning outcomes	- Be able to apply modern information technologies and have the skills to develop algorithms and computer programs using high-level languages. - Be able to apply the methods of automatic control theory to the study, analysis and synthesis of automatic control systems. - Be able to apply modelling, identification, and numerical methods to develop mathematical and simulation models of automation systems using the latest computer technologies.
Competencies and skills	- Ability to analyse automation objects based on knowledge of the processes that occur in them and apply the methods of automatic control theory to study, analyse and synthesize automatic control systems. - Ability to apply methods of mathematical modelling, identification and numerical methods to develop mathematical models of automation systems using the latest computer technologies. - Ability to freely use modern computer and information technologies to solve professional problems, program and use applied and specialized computer-integrated environments to solve automation problems.
Instructional Materials	Syllabus, Coursebooks and Teaching Resources
Delivery mode	Lectures, practical classes
End-of-semester control	Final test

Modelling of Chemical and Technological Processes	
Educational level	First (Bachelor)
Course, semester	4rd course, 7th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software department
Assumed knowledge and prerequisites	Knowledge of mathematics, physics, general chemical technology, programming, computer modelling of processes and systems
Scope of the course	The main types of mathematical models, methods of their identification.
Rationale	In connection with the high requirements for the management of technological processes and equipment, the problem of modelling processes and systems becomes extremely important. It is impossible to ensure high quality management of the object without an adequate model and means of its implementation. The ability to use computer technology to solve technical problems, to use computer integrated technologies, to use modern software to solve applied technical problems.
Learning outcomes	Expected learning outcomes include: – analyze a technical object or process as a modeling object – develop, identify and implement simulation models.; use modern software tools for computer implementation of models
Competencies and skills	Upon successful completion of the course students are expected to be able develop mathematical models of the main processes of chemical technology, using a deterministic approach with the application of the laws of conservation of matter, energy, kinetic and equilibrium characteristics of processes.
Instructional Materials	syllabus, textbooks (electronic editions)
Delivery mode	lectures, practical
End-of-semester control	final test

Typical Technological Control Objects	
Educational level	First (Bachelor)
Course, semester	4rd course, 7th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software department
Assumed knowledge and prerequisites	Automatic Control Theory. Knowledge and understanding of technological transformations of material flows in production
Scope of the course	Typical Technological Processes and Devices as Objects of Control of Their Determining Parameters
Rationale	Due to the high requirements for the quality of control of technological processes and equipment, the problem can be solved by studying and taking into account the internal relationships between the parameters of control objects. Knowledge and assessment of the degree of influence of internal connections in typical technological objects can be extended to a wide class of control objects. The presence of high-speed computing equipment in the automated process control system or CIT makes it possible to implement systems that compensate for the impact of such internal connections
Learning outcomes	In the process of studying the course, the student will gain knowledge of the features of dynamic properties of typical technological control objects and the synthesis of control systems taking into account these features.
Competencies and skills	The use of the acquired knowledge is associated with the development, implementation and operation of control systems as one of the most effective methods for improving the quality of transient characteristics and ensuring the stability of technological processes, especially as part of process in automated control systems or process of automated control.
Instructional Materials	Syllabus, manuals (electronic editions). Software Tools of Applied Mathematics.
Delivery mode	Lectures, practical classes
End-of-semester control	Final test

Elective disciplines are available for selection from the eighth semester

Optimization of Control Systems	
Chair	Automation Hardware and Software
VO level	first (*Bachelor*))
Course	4th year, 8th semester
Amount	4 ECTS credits (120 hours: 54 hours of classroom work, 66 hours of SRS)
Language of teaching	Ukrainian
Requirements for starting studies	Knowledge of process technology, mathematical modelling, theory of automatic control.
What will be studied	Construction of the upper level of automated control systems for technological processes based on modern optimization methods.
Why is it interesting/should be studied?	The acquired knowledge and skills will allow you to create, program, configure and safely operate optimal control systems
Why you can learn(study results)	▪ apply knowledge of applied mathematics, optimal control theory to the extent necessary for solving typical optimization systems in order to increase the efficiency of production management; ▪ know the principles of choosing a strategy for finding the optimal solution, synthesis of optimal control systems; ▪ perform tasks of static and dynamic optimization using application program packages.
How to use acquired knowledge and skills (competencies)	▪ apply knowledge of mathematics to the extent necessary for the use of mathematical methods for the analysis and synthesis of automation systems; ▪ perform analysis of automation objects based on knowledge of the processes taking place in them and apply methods of automatic control theory for research, analysis and synthesis of automatic control systems; ▪ apply the methods of system analysis, mathematical modelling, identification and numerical methods to develop mathematical models of individual elements and automation systems as a whole, to analyse the quality of their functioning using the latest computer technologies.
Information support	Syllabus, study aids
The form of classes	Lectures, computer workshop
Semester control	Test

Optimization of Technological Processes	
Chair	Automation Hardware and Software
VO level	first (*Bachelor*)
Course	4th year, 8th semester
Semester	8
Amount	4 ECTS credits (120 hours: 54 hours of classroom work, 66 hours of SRS)
Language of teaching	Ukrainian
Requirements for starting studies	Knowledge of technical means of automation, electronics and microprocessor technology.
What will be studied	Construction of the upper level of automated control systems for technological processes on the basis of modern mathematical models of systems.
Why is it interesting/should be studied?	The acquired knowledge and skills will allow to create, program, adjust mathematical models of systems with the aim of creating rational control solutions of control systems.
Why you can learn(study results)	▪ apply knowledge of applied mathematics, optimal control theory to the extent necessary to determine the optimal operating conditions of the technological process; ▪ to know the principles of choosing a strategy for finding the optimal solution, synthesis of optimal control systems for the selection of process optimization parameters and taking into account their limitations; * use of application program packages in the process of optimizing technological tasks
How to use acquired knowledge and skills (competencies)	▪ apply knowledge of mathematics to the extent necessary for the use of mathematical methods for the analysis and synthesis of automation systems; ▪ perform analysis of automation objects based on knowledge of the processes taking place in them and apply methods of automatic control theory for research, analysis and synthesis of automatic control systems; ▪ apply the methods of system analysis, mathematical modelling, identification and numerical methods to develop mathematical models of individual elements and automation systems as a whole, to analyse the quality of their functioning using the latest computer technologies.
Information support	Syllabus, study aids
The form of classes	Lectures, computer workshop
Semester control	Test

Industrial Internet of Things	
Educational level	First (Bachelor)
Course, semester	4rd course, 8th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and software department
Assumed knowledge and prerequisites	Mastering the regulatory disciplines “Industrial Controllers”, "Automation Systems Design" or similar.
Scope of the course	Algorithms for building UML diagrams, principles of creating Internet protocols and methods of cloud technologies
Rationale	A network concept consisting of interconnected physical devices that have built-in sensors and software that allows data to be transmitted and exchanged between the physical world and computer systems using standard communication protocols. In addition to sensors, the network may have actuators embedded in physical objects and interconnected through wired or wireless networks. IoT in everyday life simplifies life, reduces time for routine operations, allows people to do only what brings pleasure. Everything that can be done without human intervention can be done with the help of the Internet of Things: smart houses/apartments. automation of one or more household and technological processes, a smart car.
Learning outcomes	Expected learning outcomes include: – Basics of working with UML diagrams – Internet of things – Data transfer in the IIoT architecture: MQTT Cloud services in ATPCS
Competencies and skills	Upon successful completion of the course students are expected to be able to: – numerical methods and approaches of analysis; determination of characteristics and computer data of work with the object.
Instructional Materials	syllabus, textbooks (electronic editions), training stands, simulation software/
Delivery mode	lectures, practical
End-of-semester control	final test

Application the Computer-Integrated Technological Complexes	
Educational level	First (Bachelor)
Course, semester	4th course, 8th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software Department
Assumed knowledge and prerequisites	Completion of educational component “Fundamentals of design of computer-integrated technological complexes”, “Automation Systems Design” or compatible.
Scope of the course	The course covers modern automated control systems and other computer-integrated systems for industrial and non-industrial purposes
Rationale	The educational component promotes the fundamental knowledge about Information and Coding Theory and development of professional experience in advanced techniques of programming with LabVIEW environment.
Learning outcomes	Expected learning outcomes include being able to: – design of stand-alone applications in LabVIEW; – implementing Design Patterns; – use local variables to modify front panel controls; – understanding the principles of source coding as well as error-detecting and error-correcting channel coding; – determining theoretical limits of data compression and error-free data transmission over noisy channels
Competencies and skills	Upon successful completion of the course students are expected to be able to: – design control loops in LabVIEW; – design of stand-alone applications in LabVIEW; – determine the limits of data compression as well as of data transmission through noisy channels and based on those limits to design basic parameters of a transmission scheme; – estimate the parameters of an error-detecting or error-correcting channel coding scheme for achieving certain performance targets
Instructional Materials	syllabus, textbook, training equipment
Delivery mode	lectures, seminars, practical
End-of-semester control	final test

System Analysis of Technological Processes	
Educational level	First (Bachelor)
Course, semester	4rd course, 8th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and software department
Assumed knowledge and prerequisites	Mastering the regulatory disciplines: "Computer modelling of processes and systems", "Specialized problems of system analysis", "Experimental studies of technological objects", "Control objects in chemical technology".
Scope of the course	Modelling programs and their capabilities for analysis, calculation of dynamic and static modes of complex technological systems.
Rationale	The solution to the problems of sustainability of modern industries and the development of effective management systems for them can only be based on a systemic vision. Therefore, when developing and analysing any technological process and its management systems a systematic approach is necessary
Learning outcomes	Expected learning outcomes include: – knowledge of methods of system analysis used in the development of mathematical and simulation models of individual elements and systems of complex technological processes. – software tools for analysing the quality of their functioning using the latest computer technologies;
Competencies and skills	Upon successful completion of the course students are expected to be able to: – freely use modern computer and information technologies to solve professional tasks, program and use applied and specialized computer-integrated environments to solve automation tasks. – design of specialized software for solving typical engineering problems in the field of automation, in particular, mathematical modelling, automated design of complex technological processes.
Instructional Materials	syllabus, textbooks (electronic editions), simulation software
Delivery mode	lectures, practical
End-of-semester control	final test

Neural Networks in Automation Systems	
Educational level	First (Bachelor)
Course, semester	4th course, 8th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software department
Assumed knowledge and prerequisites	Programming, numerical methods. Knowledge and understanding of the principles of optimization and data analysis.
Scope of the course	Development approaches and methods of artificial neural networks implementation. Application of classical architectures of artificial neural networks to solve classical machine learning problems
Rationale	The relevance of applying the principles of machine learning, namely artificial neural networks, is due to the complexity of the tasks solved by these approaches. The use of artificial neural networks allows for high-quality management, both based on the knowledge of the "teacher" and entirely machine-generated artificial intelligence rules. All of this, together with the rapid development of artificial intelligence and computing capabilities, indicates the relevance of studying methods for developing and using artificial neural networks and their rational application in solving specific problems.
Learning outcomes	During the course, students will gain knowledge about the features of development and implementing artificial neural networks; the possibilities and feasibility of using existing classical architectures; pre-training methods and regularization methodologies. As a result of studying the course, students will learn to apply machine learning principles to solve applied technical problems.
Competencies and skills	Development and implementation of artificial neural networks is a prerequisite for the creation and implementation of a smart automated control system for technological, information and business processes.
Instructional Materials	Syllabus, textbooks (electronic editions) Experimental stands of control objects, training datasets. Software tools of computer mathematics.
Delivery mode	lectures, practical (computer workshop)
End-of-semester control	final test

Methods of Technological Systems Structures Synthesis	
Educational level	First (Bachelor)
Course, semester	4rd course, 8th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software Department
Assumed knowledge and prerequisites	Basic knowledge of mathematics, physics, chemistry, heat engineering, computer science techniques, programming, specialized software, thermal equipment, computer modeling of processes and systems.
Scope of the course	Fundamentals of energy technology. Resource and energy saving. Exergetic analysis complex technological systems. Synthesis of the optimal structure of technological processes by various methods (graphoanalytical, heuristic, based on theory of fuzzy sets, theory of pinch - analysis).
Rationale	Synthesis of the optimal structure of technological systems that are used in almost any production, is a key task from positions energy saving Knowledge of modern methods of optimal synthesis technological systems in solving practical problems is useful nowadays. The ability to use computer technology to solve technical problems, use computer-integrated technologies, apply modern one's software for solving applied technical problems.
Learning outcomes	In the process of studying the course, the student will gain knowledge about the peculiarities of the methods synthesis of optimal structures of technological systems. Expected learning outcomes include: – analyze the structure of various types of technological schemes; – create optimal structures of technological systems using various methods; – use modern software tools for computer implementation calculations.
Competencies and skills	Ability to apply knowledge of various types of analysis of typical structures technological processes when determining the thermodynamic efficiency of these processes. The ability to create optimal structures of technological systems using modern synthesis methods.
Instructional Materials	syllabus, textbooks (electronic editions), training stands, simulation software.
Delivery mode	lectures, practical (computer workshop)
End-of-semester control	final test

Fundamentals of Complex Systems and Automation Systems Reliability	
Educational level	First (Bachelor)
Course, semester	4rd course, 8th semester
Credits	4 ECTS credits
Teaching language	Ukrainian
Teaching department	Automation Hardware and Software Department
Assumed knowledge and prerequisites	Mastering the normative disciplines "Higher Mathematics", "Mathematical methods in automation tasks", "Computer modelling of processes and systems".
Scope of the course	Reliability theory and its application to complex systems and automation systems.
Rationale	A high level of extraordinary events has been observed in recent years of man-made nature, accidents and catastrophes that led to large material losses and human sacrifices, raises the question of the need for knowledge in the theory of reliability, aimed at the research and development of priorities areas of reliability improvement, accident reduction and provision security of complex technical systems. The problem of ensuring reliability is one from urgent during design, production and operation, therefore study discipline is quite relevant.
Learning outcomes	In the process of studying the course, the student will gain knowledge of quantitative characteristics reliability of objects, distribution models, calculation bases of technical systems, calculation of reliability indicators of technical systems, redundancy and reliability complex system, methods of ensuring the reliability of complex systems, logicographic methods of reliability and risk analysis, reliability of automated systems.
Competencies and skills	The ability to use modern concepts of effective technologies in production complexes; assess the dangerousness of the production complex; evaluate the reliability of complex technical systems; apply object management models in a changing technological environment.
Instructional Materials	syllabus, textbooks (electronic editions), training stands, simulation software.
Delivery mode	lectures, practical (computer workshop)
End-of-semester control	final test