

NATIONAL TECHNICAL UNIVERSITY OF UKRAINE
"IGOR SIKORSKY KYIV POLYTECHNIC INSTITUTE"

EDUCATIONAL AND RESEARCH INSTITUTE OF
AEROSPACE TECHNOLOGIES

APPROVED

Methodical Council

Igor Sikorsky Kyiv Polytechnic Institute

(protocol № 5 from 06.03.2025)

F- CATALOG

ELECTIVE EDUCATIONAL DISCIPLINES

for candidates for the degree Philosophy Doctor

according to the educational program

«Control systems of flight vehicles and complexes engineering»

Specialty 173 Avionics

(2025/2026 s.y.)

Scientific Council

Education and Research Institute of
Aerospace Technologies

Igor Sikorsky Kyiv Polytechnic Institute

(protocol № 01/25 from 27.01.2025)

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INTRODUCTION

The procedure for providing higher education students with the right to freely choose academic disciplines at the Igor Sikorsky KPI (hereinafter - the University) in accordance with the Law of Ukraine "On Higher Education" and [Regulations on the Organization of the Educational Process at Igor Sikorsky KPI \(https://osvita.kpi.ua/node/39\)](https://osvita.kpi.ua/node/39) is regulated by the [Regulations on the right to free choice of disciplines by applicants for higher education at the Igor Sikorsky KPI \(https://osvita.kpi.ua/node/185\)](https://osvita.kpi.ua/node/185), which was approved and put into effect by the rector's order dated February 14, 2023 No. HOH/42/2023.

The content of a specific optional educational discipline is determined by its syllabus - the working program of the educational discipline.

Elective academic disciplines provide the applicant with the opportunity to:

- build an individual learning trajectory;
- get acquainted with the current level of scientific research in the relevant field of knowledge;
- deepen professional training within the chosen specialty and educational program;
- to obtain additional learning outcomes.

The choice of academic disciplines is carried out within the limits provided by the relevant educational program and curriculum, in the amount of at least 25 percent of the total number of ECTS credits.

Postgraduate chooses disciplines in accordance with the curriculum he is studying, which determines the number and volume of educational disciplines of the postgraduate's free choice for a particular semester. At the same time, postgraduate has the right to choose academic disciplines offered for other educational programs, in agreement with the head of the corresponding graduation department.

The selection of disciplines from the professional Catalog (F-Catalog) by postgraduate is usually carried out at the beginning of the spring semester of the first year of study (the selected disciplines will be studied in the next academic year), unless otherwise provided by the specifics of the educational program.

The procedure for postgraduate students to choose academic disciplines from F-catalogs is implemented through the specialized information system of the University and includes the following stages:

- 1) Postgraduate registration in the specialized information system.

- 2) Implementation of the postgraduate's choice of disciplines.
- 3) Confirmation of the postgraduate's choice of academic disciplines from the F-Catalogue.
- 4) Elaboration of the results of the selection of disciplines (fixation of selection results) and transfer of data for the correction of individual study plans of graduate students.

The F-Catalog contains an annotated list of disciplines that are offered for selection by applicants of higher education of the third (educational and scientific) level of HE of the first year of study according to the curriculum for the next academic year.

LIST of selective educational components

level: third (educational and scientific)

field of knowledge: 17 Electronics, automation and electronic communications

Specialty 173 Avionics

EDUCATIONAL AND SCIENTIFIC PROGRAM:

«Control systems of flight vehicles and complexes engineering»

Graduation Department:

Aircraft Control Systems ERIAT

2. Elective educational components from interfaculty / faculty / department Catalogs					
Code	Educational components (academic disciplines)	Elective educational components (academic disciplines)	Cour se	Sem ester	ETCS Credits
V 01	Educational component 1 F-Catalog	Methods of mathematical simulation the systems of avionics	2	3	5
		Modern methods of designing control systems			
		Modern directions of unmanned aerial vehicle control systems development			
V 02	Educational component 2 F-Catalog	Modern automatic control systems of moving objects	2	4	5
		Methods for ensuring the accuracy and reliability of navigation devices and systems			
		Automated and robotic complexes and tasks of sustainable development			

Methods of mathematical simulation the systems of avionics

Department	Aircraft Control Systems ERIAT
HE level	Third (educational and scientific)
Course, semester	2 Course, fall semester
The scope of the discipline and the distribution of hours of classroom and Self-study	5 credits ECTS - 150 hours: Lectures - 26 hours; Practical - 26 hours; Self-study - 98 hours
Language of study	Ukrainian / English
Requirements for the beginning of the study	Knowledge gained in the study of disciplines: special sections of modern theory of automatic control; orientation, navigation and guidance systems for moving objects; aircraft control systems, aeronautical and navigation complexes of aircraft; pattern recognition systems.
What will be studied	The current state of development of control systems (CS) of moving objects, methods of their design and research. Problems assigned to mathematical modeling of avionics systems. Modern methods of mathematical modeling and their application in avionics problems. Modern applied packages of mathematical modeling. Their application in avionics and CS design of moving objects. Methods of mathematical and physical modeling in the design of modern CS.
Why it is interesting / necessary to study	Automatic robotic moving objects, the brain of which is a control system, are replacing human-machine systems in all spheres of human activity. The quality of work and functionality of such objects is ensured by the quality and perfection of the automatic control system, which is achieved by its professional design. Terms of design of the control system and its implementation are determined by the application of modern mathematical methods and software packages.
What you can learn (learning outcomes)	Quickly and reasonably evaluate the generated new ideas, approaches to the design of modern control systems and the possibility of their implementation; Correctly and effectively assess the capabilities of the new moving object control system; Practical work on modern applications and software packages. Organization and conduct of mathematical and physical modeling of modern control systems.
How to use the acquired knowledge and skills	Determine the feasibility and possibility and decide on the creation of the latest modern control systems for moving objects, created for use in various sectors of the economic complex; set a task and evaluate the effectiveness of the use of the latest control systems for moving objects for various purposes according to the technical requirements; to study the created modern control systems.
Information support	Syllabus, control tasks
Semester control	Examination

Modern methods of designing control systems

Department	Aircraft Control Systems ERIAT
HE level	Third (educational and scientific)
Course, semester	2 Course, fall semester
The scope of the discipline and the distribution of hours of classroom and Self-study	5 credits ECTS - 150 hours: Lectures - 26 hours; Practical - 26 hours; Self-study - 98 hours
Language of study	Ukrainian / English
Requirements for the beginning of the study	Knowledge gained in the study of disciplines: special sections of modern automatic control theory; orientation, navigation and guidance systems for moving objects; aircraft control systems, aeronautical and navigation complexes of aircraft; pattern recognition systems.
What will be studied	Current state of development and tasks that can be solved by modern control systems (CS) of robotic and mobile ground, sea, aerial, space objects. New approaches and principles of construction of modern CS. Modern and promising methods of synthesis and design of CS for moving objects and features of their application. Methods of mathematical and physical modelling for the design of modern CS.
Why it is interesting / necessary to study	Automatic moving objects, the brain of which is a control system, are replacing human-machine systems in all spheres of human activity. The quality of work and functionality of such facilities in transport, construction, agriculture, environmental monitoring, emergency response, military, etc. is ensured by the quality and perfection of the automatic control system, which is achieved by its professional design.
What you can learn (learning outcomes)	Generate new ideas, approaches to the design of modern control systems and implement them based on: - sound decision-making when choosing methods and technologies for designing modern control systems; - practical application of modern methods of design and research of control systems of moving objects; - organization and carrying out of mathematical and physical modelling of modern control systems.
How to use the acquired knowledge and skills	Determine the feasibility and possibility and decide on the need to use the latest methods of designing modern control systems for moving objects, created for use in various sectors of the economic complex; set a task and use the latest methods of building modern control systems for moving objects for various purposes according to the technical requirements; to study the created modern control systems.
Information support	Syllabus, control tasks
Semester control	Examination

Modern directions of unmanned aerial vehicle control systems development

Department	Aircraft Control Systems ERIAT
HE level	Third (educational and scientific)
Course, semester	2 Course, fall semester
The scope of the discipline and the distribution of hours of classroom and Self-study	5 credits ECTS - 150 hours: Lectures - 26 hours; Practical - 26 hours; Self-study - 98 hours
Language of study	Ukrainian / English
Requirements for the beginning of the study	Knowledge gained in the study of disciplines: special sections of modern theory of automatic control; orientation, navigation and guidance systems for moving objects; aircraft control systems; aeronautical and navigation complexes of aircraft.
What will be studied	The current state of the field of automatic flight control systems and current problems in the automatic control of the movement of unmanned aerial vehicles of various types: aircraft, multicopters, missiles and guided projectiles. Promising approaches to improving the performance of unmanned aerial vehicles by improving their control systems. Models of controlled motion of unmanned aerial vehicles. Synthesis of regulators by modern methods with the use of mathematical software packages.
Why it is interesting / necessary to study	Unmanned aerial vehicles are increasingly used in various fields of economics, science and security. The effectiveness of their use is largely determined by the perfection of automatic flight control systems. Solving current problems in the field of unmanned aerial vehicle control systems will provide developers with significant competitive advantages
What you can learn (learning outcomes)	Solve the problem of developing motion control systems for unmanned aerial vehicles. Determine their composition, synthesize control laws that can ensure high quality
How to use the acquired knowledge and skills	Determine the feasibility, possibility, and decide on the need to develop and apply modern UAV control systems that are used or can be created for use in various sectors of the economic complex; set a task and develop methods for building modern UAV control systems for various purposes according to technical requirements; to research and test modern UAV control systems.
Information support	Syllabus, control tasks
Semester control	Examination

Modern automatic control systems of moving objects

Department	Aircraft Control Systems ERIAT
HE level	Third (educational and scientific)
Course, semester	2 Course, spring semester
The scope of the discipline and the distribution of hours of classroom and Self-study	5 credits ECTS - 150 hours: Lectures - 36 hours; Practical - 18 hours; Self-study - 96 hours
Language of study	Ukrainian / English
Requirements for the beginning of the study	Knowledge gained in the study of disciplines: special sections of modern theory of automatic control; orientation, navigation and guidance systems for moving objects; aircraft control systems; aeronautical and navigation complexes of aircraft.
What will be studied	Current state of development and tasks that can be solved by automatic control systems (ACS) of autonomous moving objects (land, sea, air, space). New approaches and principles of construction of modern moving objects ACS. Selection and application of modern methods for synthesis of moving objects ACS. Principles of requirements formation to ACS of modern moving objects. Principles of ensuring the implementation of modern ACS of moving objects.
Why it is interesting / necessary to study	Autonomous and automatic robotic moving objects and their complexes replace man-machine systems in all spheres of human activity: in transport, construction, agriculture, mining, monitoring of technical, ecological condition of the environment, overcoming emergencies, military sphere and etc. The quality of their work is ensured by the quality and reliability of the automatic control system - by the brain of an automatic moving object.
What you can learn (learning outcomes)	Generate new ideas, approaches to the designing ACS of modern moving objects and implement them on the basis of: - sound decision-making when choosing methods and technologies for designing modern ACS of moving objects; - methods application of design and research ACS of moving objects; - organization of tests, mathematical and physical modelling of modern ACS of moving objects and their components.
How to use the acquired knowledge and skills	Determine the feasibility, possibility and decide on the need to develop and use modern ACS of moving objects that are used or can be created for use in various sectors of the economic complex; to set a task and develop construction methods of modern ACS of moving objects of different purpose according to the set technical requirements; to investigate and test modern ACS of moving objects.
Information support	Syllabus, control tasks
Semester control	Examination

Methods for ensuring the accuracy and reliability of navigation devices and systems

Department	Aircraft Control Systems ERIAT
HE level	Third (educational and scientific)
Course, semester	2 Course, spring semester
The scope of the discipline and the distribution of hours of classroom and Self-study	5 credits ECTS - 150 hours: Lectures - 36 hours; Practical - 18 hours; Self-study - 96 hours
Language of study	Ukrainian / English
Requirements for the beginning of the study	Knowledge gained in the study of disciplines: special sections of modern theory of automatic control; orientation, navigation and guidance systems for moving objects; aircraft control systems, aeronautical and navigation complexes of aircraft; pattern recognition systems.
What will be studied	<p>Current state of development and tasks that can be solved by navigation devices and systems of moving objects (land, sea, air, space). New approaches and principles of construction of modern navigation devices and systems of moving objects with the use of artificial intelligence, technical vision, modern information technologies. Methods of ensuring the reliability of navigation devices and systems at the design stage. Modern methods of ensuring the accuracy of navigation devices and systems and their application. Modern information and production technologies to ensure the accuracy and reliability of navigation devices and systems.</p> <p>Means of implementation of methods to ensure the accuracy and reliability of navigation devices and systems. Embedded systems and features of their application. Formation of requirements to systems of maintenance of accuracy and reliability of navigation devices and systems Technical - economic estimation of development and application of methods of maintenance of accuracy and reliability of navigation devices and systems.</p>
Why it is interesting / necessary to study	Accurate and reliable navigation devices and systems are the basis of the automatic control system - the brain of automatic moving objects that replace human-machine systems in all areas of human activity: transport, construction, agriculture, mining, environmental monitoring, overcoming emergencies, the military, etc.
What you can learn (learning outcomes)	Generate new ideas and approaches to ensure the accuracy and reliability of navigation devices and systems and implement them based on:

	<ul style="list-style-type: none"> - sound decision-making when choosing methods to ensure the accuracy and reliability of navigation devices and systems; - development and practical application of methods to ensure the accuracy and reliability of navigation devices and systems
How to use the acquired knowledge and skills	To determine the feasibility and possibility, and to make decisions about the necessity of developing and applying modern control systems for mobile objects, which are used or can be created for use in various sectors of the economic complex; to set tasks and develop methods for constructing modern control systems for mobile objects of various purposes according to the specified technical requirements; to research and test modern control systems for mobile objects.
Information support	Syllabus, control tasks
Semester control	Examination

Automated and robotic complexes and tasks of sustainable development

Department	Aircraft Control Systems ERIAT
HE level	Third (educational and scientific)
Course, semester	2 Course, spring semester
The scope of the discipline and the distribution of hours of classroom and Self-study	5 credits ECTS - 150 hours: Lectures - 36 hours; Practical - 18 hours; Self-study - 96 hours
Language of study	Ukrainian / English
Requirements for the beginning of the study	Knowledge gained in the study of disciplines: special sections of modern theory of automatic control; orientation, navigation and guidance systems for moving objects; aircraft control systems, aeronautical and navigation complexes of aircraft; pattern recognition systems, sustainable development.
What will be studied	Current state of development and tasks that can be solved by automated and robotic complexes (ARC) (land, sea, air, space), in the context of sustainable development of society. Features and tasks of approaches to the construction of modern ARC (with systems of artificial intelligence, technical vision, modern information technology) taking into account the principles and objectives of sustainable development. Principles of formation of requirements to the ARC as objects of a society of sustainable development.

Why it is interesting / necessary to study	Autonomous and automatic robotic moving objects and their complexes replace man-machine systems in all spheres of human activity: in transport, construction, agriculture, mining, monitoring of technical, ecological condition of the environment, overcoming emergencies, military sphere and etc. The needs of sustainable development become a task of harmonious combination of technocratic approaches and human needs of a comfortable society.
What you can learn (learning outcomes)	Generate new ideas, approaches to the design of the ARC with a focus on their application as systems of sustainable development society; Reasonable decision-making in the selection and design of modern ARCs as components of a sustainable development society; Practical application of methods of design and research of ARC by moving objects as components of a society of sustainable development.
How to use the acquired knowledge and skills	Be able to assess the need and feasibility of creating and applying modern autonomous robotic complexes (ARCs) for various sectors of the economy, taking into account the needs of sustainable development. This includes market and technology analysis, feasibility assessment, decision-making on ARC development, development of technical requirements, creation of ARC construction methods, as well as research and testing of human-oriented ARCs. It is important to consider current trends, such as the development of intelligent and human-oriented ARCs, their introduction into new areas, and the development of 'swarm' technologies.
Information support	Syllabus, control tasks
Semester control	Examination