

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

INSTITUTE OF AEROSPACE TECHNOLOGIES

APPROVED

Vice-Rector for Academic Affairs

_____ Anatolii MELNICHENKO

«___» _____ 2021

F- CATALOG

ELECTIVE EDUCATIONAL DISCIPLINES

CYCLE OF PROFESSIONAL TRAINING

for candidates for the degree of Doctor of Philosophy

according to the educational program

«Control systems of flight vehicles and complexes engineering»

Specialty 173 Avionics

(Enrolment 2020, 2021)

APPROVED:

Methodical Council

Igor Sikorsky Kyiv Polytechnic Institute

(protocol № _____ from _____.____.2021)

Scientific Council

Institute of Aerospace Technologies

Igor Sikorsky Kyiv Polytechnic Institute

(protocol № 2 from 22.02.2021)

Kyiv - 2021

According to Section X of Article 62 of the Law of Ukraine "On Higher Education" (№ 1556-VII of 01.07.2014), elective disciplines - disciplines of free choice of students for a certain level of higher education, aimed at providing general and special (professional) competencies for specialty. The volume of elective courses is at least 25% of the total number of ECTS credits provided for this level of education.

Regulations on the procedure for implementation by students of the Institute of Aerospace Technologies KPI. Igor Sikorsky has the right to freely choose academic disciplines, notes that students must choose disciplines from the F-catalog by submitting an application to the dean of the IAT.

The catalog contains an annotated list of disciplines offered for selection of higher education doctoral students in the first year of study for the next academic year.

LIST of selective educational components

level: third (educational and scientific)

field of knowledge: 17 Electronics and telecommunications

Specialty 173 Avionics

EDUCATIONAL AND SCIENTIFIC PROGRAM:

«Control systems of flight vehicles and complexes engineering»

Graduation Department: Control systems of flight vehicles IAT

2.2. Educational disciplines for the acquisition of universal competencies of the researcher (Elective educational components from interfaculty / faculty / department Catalogs)					
Code	Educational components (academic disciplines)	Elective educational components (academic disciplines)	Course	Semester	ETCS Credits
V 1	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 2	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			

Discipline	Modern methods of designing control systems
HE level	Third (educational and scientific)
Course	2
Amount	5 ECTS credits
Language of study	Ukrainian
Department	Aircraft control systems
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: <ul style="list-style-type: none"> - 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 (competencies)	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	Curriculum, syllabus, control tasks
Form of classes	Lectures, practical classes
Semester control	Examination

Discipline	Methods of mathematical simulation the systems of avionics
HE level	Third (educational and scientific)
Course	2 Course
Amount	5 credits ECTS
Language of study	Ukraine
Department	Aircraft control systems
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.
Why 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 (competencies)	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	Curriculum and working programs of the discipline, RSE, control tasks
Form of classes	Lectures, practical classes
Semester control	Examination

Discipline	Modern directions of unmanned aerial vehicle control systems development
HE level	Third (educational and scientific)
Course	2
Amount	5 ECTS credits
Language of study	Ukrainian
Department	Aircraft control systems
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 (competencies)	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	Curriculum, syllabus, control tasks
Form of classes	Lectures, practical classes
Semester control	Examination

Discipline	Modern automatic control systems of moving objects
HE level	Third (educational and scientific)
Course	2
Amount	5 ECTS credits
Language of study	Ukrainian
Department	Aircraft control systems
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: <ul style="list-style-type: none"> - 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 (competencies)	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	Curriculum, syllabus, control tasks
Form of classes	Lectures, practical classes
Semester control	Examination

Discipline	Methods for ensuring the accuracy and reliability of navigation devices and systems
HE level	Third (educational and scientific)
Course	2 Course
Amount	5 credits ECTS
Language of study	Ukraine
Department	Aircraft control systems
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	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

	<p>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</p> <p>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.
Why you can learn (learning outcomes)	<p>Generate new ideas and approaches to ensure the accuracy and reliability of navigation devices and systems and implement them based on:</p> <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 (competencies)	Determine the feasibility and possibility and decide on the need to develop and apply methods to ensure the accuracy and reliability of navigation devices and systems used in modern systems of automatic control of moving objects created for various sectors of the economic complex; set a task and develop methods to ensure the accuracy and reliability of navigation devices and systems according to the technical requirements.
Information support	Curriculum and working programs of the discipline, RSE, control tasks
Form of classes	Lectures, practical classes
Semester control	Examination

Discipline	Automated and robotic complexes and tasks of sustainable development
HE level	Third (educational and scientific)
Course	2 Course
Amount	5 credits ECTS
Language of study	Ukraine
Department	Aircraft control systems
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.
Why 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 (competencies)	Determine the feasibility and possibility and decide on the need to develop and use modern ARCs that are used or can be created for use in various sectors of the economic complex, taking into account the needs of a society of sustainable development; set a task and develop methods for constructing modern ARCs for various purposes according to the set technical requirements; to research and test modern human-oriented ARCs.
Information support	Curriculum and working programs of the discipline, RSE, control tasks
Form of classes	Lectures, practical classes
Semester control	Examination