NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of machine and equipment design

"APPROVED"
Dean of the Faculty of Construction and Design
_____ Zinoviy RUZHILO
"___" May 2024

"APPROVED"
at the meeting of the department
construction of machines and equipment
Minutes No. 10 of May 16th, 2024
Head of the Department
_____ Vyacheslav LOVEIKIN

"REVIEWED"
Guarantor of the AP "Machines and equipment
agricultural production"
_____ Mykola KOROBKO

CURRICULUM OF ACADEMIC DISCIPLINE
MECHATRONICS

Specialty: 133 – Mechamical engineering
Educational program: Machines and equipment of agricultural production
Faculty of Construction and Design
Developers: Doctor of Technical Sciences, Prof. Yu.O. Romasevich, doctor of technical sciences, prof. V. S. Loveykin, Ph.D. Krushelnytskyi V.V.

Kyiv - 2024

Description of the academic discipline

Mechatronics

Field of knowledge, specialty, educational program, educational degree		
Educational degree	*master*	
Specialty	*133 – Mechanical engineering*	
Educational program	*Machines and equipment of agricultural production*	
Characteristics of the academic discipline		
View	*Compulsory*	
Total hours	*180*	
Number of ECTS credits	*6*	
Number of content modules	*6*	
Course project (work) (if available)	-	
Form of control	*Exam, assessment*	
Indicators of academic discipline for full-time education		correspondence form of study
Course (year of training)	*1*	*1*
Semester	*1 and 2*	*2*
Lecture classes	*60 hours*	*8 hours*
Practical, seminar classes	-	
Laboratory classes	*60 hours*	*8 hours*
Independent work	*60 hours*	*134 hours*
Individual tasks	-	
Number of classrooms per week hours for full-time education	*6 hours - 1 semester* *2 hours - 2nd semester*	

1. Aim, objectives, competencies and program results of the educational discipline

The aim of studying the discipline "Mechatronics" within the "Industrial Mechanical Engineering" specialty is to provide students with theoretical knowledge and practical skills in the integration of mechanical, electronic and software components to create complex and functional mechatronic systems. The main **tasks** of studying the discipline "Mechatronics" within the "Industrial Mechanical Engineering" specialty include:

1. Understanding the basic principles and concepts of mechatronics: students get acquainted with the principles of functioning of mechatronic systems, study the basics of mechanics, electronics, control and programming;

2. Acquisition of theoretical knowledge and skills in the development of mechatronic systems: students study methods of analysis, design and modeling of mechatronic systems, including the selection and integration of components, development of control algorithms and software;
3. Study of modern technologies and trends in mechatronics: students explore modern advances in the field of mechatronics, such as robotics, autonomous systems, artificial intelligence, the Internet of Things and other innovative developments;
4. Development of practical skills and ability to implement mechatronic systems: students gain practical experience in the design, assembly, debugging and testing of mechatronic devices and systems. They study the processes of production and optimization of mechatronic systems, as well as learn the methods of maintenance and repair;
5. Fostering creative thinking and engineering thinking: students learn to analyze problems, find innovative solutions, and use a creative approach to designing mechatronic systems.

After successfully studying the discipline "Mechatronics", students of the specialty "Industrial Mechanical Engineering" will have the necessary knowledge and skills for the design, production and operation of complex mechatronic systems in various fields, such as production automation, robotics and many others.

Competence acquisition:

integral competence (IC): with the ability to solve complex tasks and problems of industrial engineering, which involve research and/or innovation and are characterized by uncertainty of conditions and requirements.

general competences (CG):

GC1. Ability to use information and communication technologies.
GC2. Ability to learn and master modern knowledge.
GC3. Ability to search, process and analyse information from various sources.
GC6. Ability to generate new ideas (creativity).
GC7. Ability to identify, formulate and solve problems.
GC8. Ability to make informed decisions.
GC9. Ability to work in a team.

professional (special) competences (SC):

SC1. Ability to create, improve and apply quantitative mathematical, scientific and technical competencies (SC) methods and computer software, apply a systematic approach to solving engineering problems of industrial engineering, in particular, in conditions of technical uncertainty.

SC3. Ability to create new equipment and technologies in the field of mechanical engineering.

SC4. Awareness of the prospective tasks of modern production aimed at meeting the needs of consumers, knowledge of trends in innovative development of industry technologies.

SC6. Ability to evaluate, control and manage the processes of design, manufacture, testing, repair of agricultural machinery and equipment. production.

Program learning outcomes (PLO):

PLO1. Knowledge and understanding of the principles of technological, fundamental and engineering sciences that underlie industrial engineering and, in particular, agricultural engineering.

PLO2. Knowledge and understanding of mechanics and mechanical engineering and prospects for their development.

PLO3. To know and understand the processes of industrial engineering, to have the skills of their practical use.

PLO4. Perform engineering calculations to solve complex problems of practical problems in industrial engineering.

PLO6. Find the necessary scientific and technical information in available sources, including in a foreign language, analyse and evaluate it.

2. The program and structure of the academic discipline for:

– full-time full-time education;

- reduced term of full-time education.

Names of content modules and topics	Number of hours									
	weeks	total	including					correspondence form		
			l	p	lab	ind	s.r.	l	lab	sr
Semester 1										
Content module 1 . Microcontrollers in mechatronic systems										
Topic 1. Microcontroller structure	1	5	2	-	3	-	-	1	1	22
Topic 2. I/O ports of microcontrollers	1-2	5	2	-	3	-	-			
Topic 3. Sensor-microcontroller interfaces (SPI , UART , I^2C)	2-3	16	3	-	3	-	10			
Together according to content module 1		26	7	-	9	-	10			22
Content module 2. DAC and ADC in mechatronic systems										
Topic 1. Discrete and analog forms of data representation. Advantages of digital systems	3-4	5	2	-	3	-	-	1	1	22
Topic 2. General characteristics and schemes of ADC	4-5	5	2	-	3	-	-			
Topic 3. General characteristics and schemes of TsAP	5-6	5	2	-	3	-	-			
Topic 4. Counting theorem and its practical consequences	6	12	2	-	-	-	10			
Together according to content module 2		27	8	-	9	-	10	2	2	22

Content module 3. Sensors of mechatronic systems										
Topic 1. Sensors of mechanical quantities	6-7	18	5	-	3	-	10	1	1	22
Topic 2. Sensors of electromagnetic quantities	7-9	8	5	-	3	-	-			
Topic 3. Sensors for measuring hydraulic and thermal quantities	9-10	6	3	-	3	-	-	1	1	
Topic 4. Operational amplifier	10	5	2	-	3	-	-			
Together according to content module 3		37	15	-	12	-	10	2	2	22
Content module 4. Drives of mechatronic systems										
Topic 1. Requirements for drives, quality indicators of drive regulation	11	5	2	-	3	-	-	2	2	22
Topic 2. Controlled DC electric drive	11-12	7	4	-	3	-	-			
Topic 3. Stepper motors	13-14	17	4	-	3	-	10			
Topic 4. Asynchronous electric drive with frequency control	14-15	11	5	-	6	-	-			
Together according to content module 4		40	15	-	15	-	10	2	2	22
Together for 1 semester	-	130	45	-	45	-	40	6	6	88
Semester 2										
Content module 5. PID controllers in traffic control systems cars										
Topic 1. Classical PID controller and its partial cases	1	12	2	-	-	-	10	1	1	23
Topic 2. About the ability of real PID-regulators	2	2	2	-	-	-	-			
Topic 3. The most common modifications of PID regulators	3	2	2	-	-	-	-			
Topic 4. Methods of setting PID regulators	4-8	9	2	-	7	-	-			
Together according to content module 5	-	25	8	-	7	-	10	1	1	23
Content module 6 . About dreams of intelligent traffic management systems cars										
Topic 1. Fundamentals of fuzzy traffic control systems	8-12	7	3	-	4	-	-	1	1	23
Topic 2. Fundamentals of motion control systems based on artificial neural networks	12-15	13	4	-	4	-	10			
Together according to content module 6	25			-	8	-	10	1	1	23
Together for 2 semesters	50		15	-	15	-	20	2	2	46
Only hours	180		60	-	60	-	60	8	8	134

3. Topics of laboratory (practical, seminar) classes

No s/p	Topic name	Number hours
1.	Analog comparator	3
2.	Microcontroller input/output ports	3
3.	SPI interface	3
4.	Tensometric sensors	3
5.	Magnetic encoders	3
6.	Temperature sensors	3
7.	Operational amplifiers	3
8.	Analog-digital converter	3
9.	Software implementation of ADC bit rate change	3
10.	Digital-analog converters	3
11.	Electric servo drive	3
12.	Direct current collector motor control	3
13.	Stepper motor control	3
14.	Asynchronous electric drive with frequency control	6
15.	Setting the coefficients of the PID controller using the PID Tuner Controller web application	3
16.	Setting the coefficients of the PID regulator using the Wolfram Cloud web application	4
17.	Study of the fuzzy speed controller machinery	4
18.	The development of a neuroregulator of movement of the s.g. machinery	2
19.	Learning an artificial neural network using the Wolfram Cloud web application	2

4. Topics of independent work

No s/p	Topic name	Number hours
1	Types of optical encoders, and schemes of their connection and signal processing	10
2	Practical consequences of the Kotelnikov-Nyquist-Shannon theorem	10
3	Drivers for rock engines	10
4	UART sensor-microcontroller interfaces	10
5	And the analysis of applied areas of application of fuzzy control in the field of science and technology. cars	10
6	Application of control systems in agricultural machines based on artificial neural networks	10

5. Means of diagnosis of learning outcomes:

When teaching this discipline, diagnostic tools are used: exam; test; module tests; abstracts; protection of laboratory works.

6. Teaching methods.

When teaching this discipline, the following are used: verbal method (lecture, discussion, interview, etc.); practical method (laboratory classes); visual method (illustration method, demonstration method); work with educational and methodical literature (noting, summarizing, annotating, reviewing, writing an essay); video method (remote, multimedia, web-oriented, etc.); independent work (task performance); individual research work of students of higher education.

7. Assessment forms.

When teaching this discipline, the following are used: exam; test; oral or written survey; unit testing; abstracts; protection of laboratory works; presentations and speeches at scientific events .

8. Distribution of points received by higher education applicants.

The assessment of the knowledge of a higher education student takes place on a 100-point scale and is translated into national assessments according to the table. 1 of the current "Exam and Credit Regulations at NULES of Ukraine".

The rating of the applicant of higher education, points	The assessment is national and the results of the assembly	
	exams	credits
90-100	perfectly	counted
74-89	good	
60-73	satisfactorily	
0-59	unsatisfactorily	not counted

To determine the rating of the applicant of higher education from mastering the discipline $\mathbf{R}_{\text{DIS}}$ (up to 100 points) the received rating from the certification (up to 30 points) is added to the rating of the applicant of higher education from the educational work $\mathbf{R}_{\text{НП}}$ (up to 70 points): $\mathbf{R}_{\text{ДИС}} = \mathbf{R}_{\text{НП}} + \mathbf{R}_{\text{АТ}}$.

9. Educational and methodological support

1. Mechatronics: a textbook / V.S. Loveykin, Yu.O. Romasevich, V.V. Krushelnytskyi. - K.: CP "Comprint", 2020. - 404 p .;
2. abstracts of lectures and their presentations (in electronic form);
3. methodical materials on the study of the academic discipline for students of higher education full-time and part-time forms of higher education.

10.Recommended sources of information

1. Mechatronics [Electronic resource] - Resource access mode: https :// uk . Wikipedia . org / wiki / Mechatronics.
2. Fundamentals of mechatronics: teaching. manual / O.M. Artyukh, O.V. Dudarenko, V.V. Kuzmin et al. Zaporizhzhia: NU "Zaporizhia Polytechnic", 2021. - 372 p.
3. THE MECHATRONICS HANDBOOK. Editor-in-Chief Robert H. Bishop. CRC PRESS. 2002. 1229 p. http://www.sze.hu/~szenasy/Szenzorok%20%E9s%20aktu%E1torok/Szenzakt%20nyedekedek/Mechatronics_handbook%5B1%5D.pdf
4. Basics of mechatronics: study guide / S.M. Peresada, M.V. Pushkar – Electronic text data. – Kyiv: KPI named after Igor Sikorskyi, 2020. – 137 p.
5. Modern electromechatronic complexes and systems: training. manual / T.P. Pavlenko, V.M. Shavkun, O.S. Kozlova, N.P. Lukashov; Kharkiv. national city university farm named after O. M. Beketova. – Kharkiv: XNUMX named after O. M. Beketova, 2019. - 116 p.