Ministry of Education and Science of Ukraine
Sumy National Agrarian University
Faculty of Engineering and Technology
Department of Technical Service and Industrial Mechanical Engineering

Work program (syllabus) of the educational component

3D-engineering of unmanned systems

(selective)

Implemented within the educational program

"Precision farming systems"

(name)

in the specialty *H7 "Agroengineering"*

(code, name)

second (master's) level of higher education

Sumy – 2026

Developer: _____ *Mykhailo DUMANCHUK, Ph.D., associate professor*
(first name SURNAME) (academic degree and title, position)

Considered, approved and ratified at the meeting of the Department of Technical Service and Industrial Mechanical Engineering_____ (name of department)	protocol dated _15.06.2026 _____.№_17_ Head of the Department_____*Yevhen KONOPLYANCHENKO*

Agreed:

Educational program guarantor _____ _____
(signature) (first name LAST NAME)

Dean of the faculty
where the educational program is implemented _____ Svitlana KHURSENKO
(signature)(first name SURNAME)

Review of the work program (attached) provided by: _____ Oleksandr IVCHENKO
(signature) (first name SURNAME)

_____ *Yevhen KONOPLYANCHENKO*
(signature) (first name SURNAME)

Methodologist of the Department of Educational Quality,
licensing and accreditation _____ (*Nadiya BARANIK*)
(signature) (first name SURNAME)

Registered in the electronic database: date: _____29.06_____2026.

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Information on reviewing the work program (syllabus):

Academic year in which changes are made	Number of the appendix to the work program with a description of the changes	Changes reviewed and approved		
		Date and number of the minutes of the department meeting	Head of the Department	Educational program guarantor

1. GENERAL INFORMATION ABOUT THE EDUCATIONAL COMPONENT

1.	Name OK	3D engineering of unmanned systems							
2.	Faculty/department	Faculty of Engineering and Technology / Department of Technical Service and Industrial Mechanical Engineering							
3.	Status OK	selective							
4.	Program/Specialty (programs) of which the OK for (to be filled in for mandatory OKs) is a component								
5.	The OK can be offered for (filled in for selective OKs)	OPP "Precision Agriculture Systems"							
6.	NRC level	Level 7							
7.	Semester and duration of study	STZ: 2nd semester, 15 weeks							
8.	Number of ECTS credits	5							
9.	Total hours and their distribution 150 hours	Contact work (classes)						Independent work	
		Lectures		Practical/seminar		Laboratory			
		Daily	Zaoch	Daily	Zaoch	Daily	Zaoch	Daily	Zaoch
		30		30		-	-	90	
10.	Language of instruction	Ukrainian							
11.	Teacher/Educational Component Coordinator	Dumanchuk Mykhailo Yuriyovych							
11.1	Contact information	Aud. 301m; (050) 302-62-93; md2012@i.ua							
12.	General description of the educational component	The educational component is aimed at students acquiring and deepening their competencies in the practical application of modern software packages for designing machines, mechanisms and other products.							
13.	Purpose of the educational component	Acquisition and mastery by students of the theoretical foundations of engineering and automated design used in the development and modeling of technical means of agro-industrial production and obtaining skills in solving engineering problems of designing complex technical systems using CAD, the application of digital methods of engineering analysis and 3D prototyping.							
14.	Prerequisites for studying OK, connection with other educational components of OP	The educational component is based on knowledge and skills in solving specialized practical problems in the field of designing technical means of agro-industrial production.							
15.	Academic Integrity Policy	The system of requirements that are placed on a higher education applicant when studying the educational component: • students completing assessment stages within the established deadlines; • completion and defense of written and practical work within the established deadlines; • compliance with the Regulations on the procedure for checking academic and scientific texts for uniqueness when performing written work (https://surl.li/ksidbs); • applicants' compliance with the SNAU code of academic integrity (https://surl.li/yzxgnv). Written works prepared for assessment must be original and completed independently by the higher education applicant. Written works that are completed and submitted after the deadline without good reason are evaluated with a score lower than the result obtained. Works that are completed with a low level of uniqueness or are a copy of “someone else’s” work will be evaluated with a score of “zero” with subsequent performance of the work according to another original individual task.							

		Re-submission of written works occurs after repeated performance or revision. Copying from various sources of information (including using mobile devices and gadgets) during exams is prohibited. If the fact of copying is detected, the student's work is canceled and the exam is re-taken. Re-taking of the exam is carried out with the permission of the dean's office within the specified time limits after re-learning the material from the educational component.
16.	Link to the course in Moodle	https://cdn.snau.edu.ua/moodle/course/view.php?id=5528
17	Keywords	Engineering, 3d model, design, machine, mechanism, drawing, digital technologies, CAD, autonomous machine

2. LEARNING OUTCOMES BY EDUCATIONAL COMPONENT AND THEIR RELATIONSHIP WITH PROGRAM LEARNING OUTCOMES

Learning outcomes for OK: After studying the educational component, the student is expected to be able to...	How is RND assessed?
DRN 1. Be able to create 3D models of designed technical systems using modern software packages	Execution and defense of reports on practical work according to the individual version. Written survey (testing) of the assimilation of lecture material. Intermediate computer certification - multiple choice test.
DRN 2. Design new or improve existing agricultural machines, mechanisms, and technical equipment.	Execution and defense of reports on practical work according to the individual version. Written survey (testing) of the assimilation of lecture material. Intermediate computer certification - multiple choice test.
DRN 3. Describe the structure and explain the principle of operation of agricultural machines and mechanisms	Execution and defense of reports on practical work according to the individual version. Written survey (testing) of the assimilation of lecture material. Intermediate computer certification - multiple choice test.
DRN 4. Be able to apply computer methods of static and dynamic analysis to improve technical systems.	Execution and defense of reports on practical work according to the individual version. Written survey (testing) of the assimilation of lecture material. Intermediate computer certification - multiple choice test.
DRN 5. Be able to prepare 3D models for reproduction using 3D printing.	Execution and defense of reports on practical work according to the individual version. Written survey (testing) of the assimilation of lecture material. Intermediate computer certification - multiple choice test.

3. CONTENT OF THE EDUCATIONAL COMPONENT (COURSE PROGRAM)

Topic. List of issues to be addressed within the topic	Distribution within the overall time budget				Recommended reading
	Classroom work			Independent work	
	Luke	P.z / sem.z	Lab. with.		
*Topic 1. Modeling and its varieties.*Basic concepts and definitions. Functions and purpose of modeling. Material modeling. Mathematical modeling. Analog modeling. Computer modeling	4	2		6	[1], [2], [4], [6], [9], [11], [18], [19]
Topic 2. Features of the structure and design of unmanned aerial vehicles for agricultural purposes. The role and areas of application of UAVs in modern agriculture. Classification and design features of agricultural UAVs. Structure of an unmanned aerial vehicle. Features of designing agricultural UAVs. Flight automation and digital technologies. Prospects for the development of agricultural UAVs	2	2		10	[5], [6], [7], [10], [11], [12], [13]
Topic 3. Designing computer 3D models. Types of documents and objects being designed. 2D design methods. Operations for creating bodies of revolution. Operations for creating body parts. Operations for creating sheet metal parts. Creating a 3D model of a part. Creating a 3D model of an assembly unit.	6	8		14	[1], [3], [4], [5], [6], [8], [9], [12], [17], [21]
Topic 4. 3D modeling system "PTC Creo". Purpose and functions of the "PTC Creo" system. Types of documents and objects that are modeled. System interface. Creating a 3D model of a part. Creating a 3D model of an assembly unit.	2	4		12	[1], [3], [4], [5], [6], [8], [9], [12], [17], [21]
Topic 5 3D modeling system "SolidWorks". Purpose and functions of the SolidWorks system. Types of documents and objects that are modeled. System interface. Creating a 3D model of a part. Creating a 3D model of an assembly unit. Static analysis module. Motion research module	6	4		14	[2], [3], [4], [5], [6], [8], [9], [10], [12], [14]
Topic 6. Kinematic modeling of technical systems. Simulation of the assembly-disassembly process of a machine. Determination of the trajectory and sequence of movement of components. Kinematic relationships between product components. Determination of the initial link of movement. Modeling the movement of dependent links.	2	4		8	[1], [3], [4], [5], [6], [7], [8], [12], [15], [22]
Topic 7. Analysis of the stress-strain state of the machine. Basics of stress-strain analysis of a machine. Finite element method. Determination of the mechanism loading scheme. Constraints and interaction of mechanism components. .	4	4		14	[2], [3], [4], [5], [6], [8], [9], [10], [12], [14]
Topic 8. 3D printing and its role in the development of unmanned technical systems. Basic principles of 3D printing. Technologies and technical means of 3D printing. Materials for 3D printing. Preparing a 3D model for printing. 3D printing software.	4	2		12	[6], [8], [9], [14]
Total	**30**	**30**		**90**	

4. METHODSTEACHING AND LEARNING

DRN	**Teaching methods**(work that will be carried out by the teacher during classroom lessons, consultations)	**Number of hours**	**Teaching methods**(what types of learning activities should the student perform independently)	**Number of hours**
DRN 1	Showing examples of solving production problems using an interactive method during lectures and practical classes	10	Preparing for the lecture by reviewing the previous material. Studying the material for independent mastery. Completing the practical work tasks, the implementation of which was started in the practical lesson.	15
DRN 2	Showing examples of solving production problems using an interactive method during lectures and practical classes	10	Preparing for the lecture by reviewing the previous material. Studying the material for independent mastery. Completing the practical work tasks, the implementation of which was started in the practical lesson.	15
DRN 3	Showing examples of solving production problems using an interactive method during lectures and practical classes	10	Preparing for the lecture by reviewing the previous material. Studying the material for independent mastery. Completing the practical work tasks, the implementation of which was started in the practical lesson.	15
DRN 4	Showing examples of solving production problems using an interactive method during lectures and practical classes	10	Preparing for the lecture by reviewing the previous material. Studying the material for independent mastery. Completing the practical work tasks, the implementation of which was started in the practical lesson.	15
DRN 5	Showing examples of solving production problems using an interactive method during lectures and practical classes	10	Preparing for the lecture by reviewing the previous material. Studying the material for independent mastery. Completing the practical work tasks, the implementation of which was started in the practical lesson.	15

5. EVALUATION BY EDUCATIONAL COMPONENT

5.1. Diagnostic assessment (indicated as needed)

5.2. Summative assessment

5.2.1. To assess the expected learning outcomes, there are

No.	Summative assessment methods	Points / Weight in the overall score	Date of compilation
1.	Completion and defense of practical work	*70 points / 70%*	Week 15
2.	Intermediate Computer-Based Testing - Multiple Choice Test	*10 points / 10%*	Week 7
3.	computer-based testing - multiple choice test	*20 points / 15%*	Week 15

5.2.2. Evaluation criteria

Component	***Unsatisfactorily***	***Satisfactorily***	***Good***	***Perfectly***
Execution and defense of laboratory and graphic works	*<42 points*	*42-52*	*53-62 points*	*63-70 points*
	Task requirements not met	*Most requirements are met, but some components are*	*All task requirements have been met, but there are minor*	*All task requirements have been met, and your own solution to*

		missing or insufficiently disclosed	*comments regarding the design.*	*the task has been proposed.*
Computer-based testing - multiple choice test	*<6 points*	*6-7*	*8 points*	*>8 points*
	Less than 60% correct answers	*Correct answers 60% to 75%*	*Correct answers from 76% to 89%*	*90% or more correct answers*
Computer-based testing - multiple choice test	*<12 points*	*12-14*	*15-17 points*	*>17 points*
	Less than 60% correct answers	*Correct answers 60% to 75%*	*Correct answers from 76% to 89%*	*90% or more correct answers*

5.3. Formative assessment:

To assess current progress in learning and understand areas for further improvement,

No.	Elements of formative assessment	Date
1	*Correctly completed tasks during practical classes with feedback from the teacher*	Within 1-15 weeks
2	*Verbal feedback from the teacher while working on assignments during classes.*	Within 1-15 weeks

6. LEARNING RESOURCES (LITERATURE)

Main sources

1. Artyukh O. M., Dudarenko O. V., Kuzmin V. V., etc. Fundamentals of CAD in automotive engineering: textbook. – Zaporizhzhia: National University “Zaporizhzhia Polytechnic”, 2021. – 168 p.
2. Saenko S. Yu. Fundamentals of CAD / S. Yu. Saenko, I. V. Nechiporenko – Kh.: KhDUKHT, 2023. – 120 p.
3. Barandych K.S., Podolyan O.O., Gladskyi M.M. Automated design systems: lecture notes [Electronic resource]: teaching aids – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2021. – 97 p.
4. Computer-aided design systems: lecture notes [Electronic resource]: teaching aids for students of specialty 151 "Automation and computer-integrated technologies", specialization "Computer-integrated systems and technologies in instrument making" / Igor Sikorsky Kyiv Polytechnic Institute; authors: K.S. Barandych, O.O. Podolyan, M.M. Gladsky. – Electronic text data (1 file 3.05 MB). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2021. – 97 p.
5. Shulyak M., Mikulina M., Mudryi Ya., Pirogov V. The impact of the use of unmanned aerial vehicles on increasing the efficiency of the technological process in crop production. Bulletin of NTU "KhPI". Series: Automobile and tractor manufacturing. 2023. No. 1. DOI: 10.20998/2078-6840.2023.1.13.

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Additional sources

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8. Gervas O.G. CAD of environmental objects. Educational and methodological manual – Uman: Vizavi, 2018. - 160 p.
9. Martynov I.E., Merkulov V.S., Shovkun V.O., Bizyuk I.G. Automated rolling stock design systems: workshop – Kharkiv: UkrDUZT, 2020. – 91 p., fig. 40, tab. 6.
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15. Tymchenko A. A. Fundamentals of system design and system analysis of complex objects: Fundamentals of CAD and system design of complex objects: Textbook / edited by V.I. Bykova. - 2nd ed. - K.: Lybid, 2003. - 272 p.
16. Yeshchenko O.A. Fundamentals of CAD [Electronic resource]: lecture notes for students of the direction 6.050503 “Mechanical Engineering” full-time and part-time forms of study. / Yeshchenko O.A., R.L. Yakobchuk, Zmievsky Y.G. – K.: NUHT, 2014. – 205 p.
17. DSTU 3321_2003 Design documentation system. Terms and definitions of basic concepts. – [Effective from 2003-12-08]. Official edition. Kyiv: State Standard of Ukraine, 2005. 51 p.
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