

**NATIONAL UNIVERSITY OF LIFE
AND ENVIRONMENTAL SCIENCES OF UKRAINE**

Department of tractors and automobiles

"APPROVED"

Dean of the faculty

(Zinoviy RUGHYLO)

2024



"APPROVED"

at the meeting of the department of tractors
and automobiles

Protocol No. 10 of May 20, 2024

Head of the department

(Evhen KALININ)

"CONSIDERED"

Guarantor of the EPP "Machines and Equipment".
agricultural production"

doctor of science; professor

(Mykola KOROBKO)

WORKING PROGRAM OF EDUCATIONAL DISCIPLINE

Energy-ecological assessment of machine design

Specialty: 133 "Industrial engineering"

Educational program: Machines and equipment of agricultural production

Faculty of Construction and Design

Developer: doctor of technical sciences, professor Kalinin E.

Kyiv – 2024

Description of the academic discipline
Energy-ecological assessment of machine design

Field of knowledge, specialty, educational program, educational degree		
Educational degree	<i>master</i>	
Specialty	<i>133 "Industrial engineering"</i>	
Educational program	<i>Machines and equipment of agricultural production</i>	
Characteristics of the academic discipline		
Type	mandatory	
Total hours	150	
Number of ECTS credits	5	
Number of content modules	2	
Course project (work) (if available)	-	
Form of control	<i>exam / assessment</i>	
Indicators of the academic discipline for full-time and part-time forms of higher education		
	Full-time form of higher education	Correspondence form of obtaining higher education
Course (year of training)	1	1
Semester	1, 2	1
Lecture classes	45	8
Practical, seminar classes	-	
Laboratory classes	45	6
Independent work	60	136
Number of weekly classroom hours for full-time higher education	4, 2	

1. Purpose, tasks, competencies and program results of the educational discipline

The *purpose* of teaching the discipline is to prepare students to independently solve professional tasks in the field of ecological agricultural machinery and road transport with the requirements of professional and qualification characteristics.

The *main tasks* of the educational discipline are the formation in students of a complex of knowledge, abilities, skills and ideas, which are necessary for solving professional tasks related to the justification of the choice of the engine type and highly efficient air supply and fuel supply systems with the simultaneous use of HV recirculation and neutralization systems in modern mobile energy means for increasing their technical and economic indicators and improving the environmental properties of ATZ used in the

agricultural industry, training specialists to independently solve production and functional duties at the level of requirements for the specialty and independently solve professional tasks in the field of natural sciences.

As a result of studying the discipline, students should **know**:

– the state of modern production and operation of modern ecological mobile energy means (EMEM);

– directions of development of various types of EMEM;

– prospects of using specific constructive solutions;

– the state of the country's fuel and energy complex and its changing trends;

- achievements in related areas of technology (technology of obtaining fuels, battery, capacitor, energy storage, fuel cells, etc.).

be able:

– choose the type of EMEM;

– evaluate its technical level and indicators of the quality of the work process;

– outline ways to solve the task;

– analyze the results of the conducted patent search;

– choose a promising type of fuel;

– determine installation parameters for vehicles with automatic gearboxes, as well as for hybrid 4 power plants.

Competence acquisition:

general competences (GC):

GC 2. Ability to learn and master modern knowledge.

GC 3. Ability to search, process and analyze information from various sources.

GC 4. The ability to be critical and self-critical.

GC 5. Ability to adapt and act in a new situation.

GC 7. Ability to identify, pose and solve problems.

GC 8. Ability to make informed decisions.

GC 9. Ability to work in a team.

special (professional) competences (SC):

SC4. Awareness of promising tasks of modern production, aimed at meeting the needs of consumers, mastering the trends of innovative development of industry technologies.

SK5. Ability to develop and implement plans and projects in the field of mechanical engineering and related types activities, to carry out the relevant business actions

SC6. The ability to evaluate, control and manage the processes of design, manufacture, testing, repair of machines and equipment of agricultural production.

Expected learning outcomes (ELO):

ELO2. Knowledge and understanding of mechanics and mechanical engineering and prospects for their development.

ELO3. To know and understand the processes of industrial mechanical engineering, to have skills in their practical use.

ELO4. Carry out engineering calculations to solve complex problems of practical problems in industrial mechanical engineering.

ELO5. Analyze engineering objects, processes and methods.

ELO7. To prepare the production and operate products of industrial engineering during the life cycle.

2. The program and structure of the academic discipline for a full-time (correspondence) form of higher education

Names of content modules and topics	Number of hours													
	daytime form							extramural form						
	weeks	altogether	including					weeks	altogether					
			lect	pr	lab	lect	i.w.		lect	п	лаб	інд	с.р.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Content module 1.														
General regulations of recirculation of spent gases of internal combustion engines														
Topic 1. Introduction. Exhaust gas recirculation systems of mobile vehicle engines	1	13	4		4		5		1		1			12
Topic 2. General provisions on HV neutralization systems of engines of mobile vehicles	2	13	4		4		5		1					12
Topic 3. Release and cleaning systems of HV gas engines and gas engines	3	13	4		4		5				1			12
Topic 4. Emission and purification systems of HV gas diesels and gas engines for trucks and buses	4	13	4		4		5			1		1		12
Topic 5. Release and purification systems of HV gasoline engines with distributed supply and direct fuel supply to the cylinder	5	13	4		4		5		1					12
Topic 6. Exhaust gas release and neutralization systems of motor vehicle diesel engines	6	13	4		4		5					1		12
Together according to content module 1	78		24		24		30		4		4		72	
Content module 2.														
Design features and principle of operation of combined exhaust gas cleaning systems														
Topic 7. Design features and principle of operation of combined HV cleaning systems for diesel passenger cars and minibuses.	7	16	5		5		6		1					12
Topic 8. Design features and principle of operation of combined HV cleaning systems for diesel trucks, buses and tractors	8	14	4		4		6		1					12
Topic 9. Features of the design and principle of operation of the main components of the	9	14	4		4		6							12

SCR system of FTP diesel engines												
Topic 10. Design features of the catalytic converter of exhaust gases with stabilizers made of rare earth metals	10	14	4		4		6		1		1	14
Topic 11. Concept of control of harmful emissions of mobile vehicles	11	14	4		4		6		1		1	14
Together according to content module 2	72		21		21		30		4		2	64
Total hours	150		45		45		60		8		6	64
Course project				-	-		-		-	-	-	-
Total hours	150		45		45		60		8		6	136

3. Topics of laboratory classes

№	Topic name	Number of hours
1	Use of exhaust gas recirculation systems in vehicles with gasoline internal combustion engines	6
2	Use of exhaust gas recirculation systems in transport with diesel internal combustion engines	6
3	Application of exhaust gas neutralization systems in ecological mobile vehicles	6
4	Application of exhaust gas neutralization systems in gas engines and gas diesels	6
5	Application of exhaust gas neutralization systems in gas diesels and gas engines for trucks and buses	6
6	Application of exhaust gas neutralization systems in gasoline internal combustion engines with distribution and direct fuel supply to the cylinder for passenger cars	5
7	Application of exhaust gas neutralization systems in passenger vehicle diesels	5
8	Application of combined exhaust gas neutralization systems in diesel engines of trucks, buses and tractors	5

4. Topics of independent work

№	Topic name	Number of hours
1	Toxic substances, types of internal combustion engine. Industrial waste of transport activity	7
2	Liquid hydrocarbon motor fuels (oil) and oil composition	7
3	Ecology of automobile gasoline. The effect of fuel properties and additives on the quality of work and durability of a diesel engine. Alternative fuels for diesels	7
4	Composition of exhaust gases. Toxicity	7
5	Reducing the toxicity of exhaust gases with an impact on the work process in compression ignition internal combustion engines	7
6	Standardization of the toxicity of exhaust gases in internal combustion engines with spark ignition	7
7	Control of the toxicity of exhaust gases on a stand with running drums	6
8	Smoke control of exhaust gases during operation of diesel engines	6
9	Neutralization of exhaust gases. Three-component catalytic converters. Denox neutralizer. Exhaust gas recirculation system. Recirculation system for diesel internal combustion engines	6

5. Means of diagnosis of learning outcomes:

- exam;
- settlement;
- module tests.

6. Teaching methods:

- verbal method (lecture, discussion, interview, etc.);
- practical method (laboratory, practical classes);
- visual method (illustration method, demonstration method);
- working with educational and methodical literature (summarizing, summarizing, annotating, reviewing, writing an abstract);
- video method (remote, multimedia, web-oriented, etc.); - independent work (task performance).

7. Evaluation methods

- exam;
- settlement;
- oral or written survey;

- modular testing;
- protection of laboratory and practical works.

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 "Regulations on examinations and assessments at NUBiP of Ukraine".

Rating of a higher education applicant, points	The assessment is national and the results of the assembly	
	exams	credits
90-100	excellent	pass
74-89	good	
60-73	satisfactorily	
0-59	unsatisfactorily	fail

In order to determine the rating of a higher education applicant for mastering the R_{DYS} discipline (up to 100 points), the obtained rating from the certification (up to 30 points) is added to the rating of a higher education applicant for the educational work of the R_{HP} (up to 70 points): $R_{DYS} = R_{HP} + R_{AT}$.

8. Educational and methodological support

- abstracts of lectures and their presentations (in electronic form);
- methodical materials on the study of the academic discipline for students of higher education full-time and part-time forms of higher education.

9. Recommended sources of information

1. Astley Hastings, John D. Nelson, Catherine G. Logan. The book "Transportation in a Net Zero World: Transitioning Towards Low Carbon Public Transport". Kyiv: Green Energy and Technology 2023, 115
2. Francesca Pagliara, M. R. Dilip. The book "Transportation Systems for Tourism". Kyiv: Advances in Spatial Science 2023, 350
3. Juan Carlos Villa, Maria Boyle, Soterios Teofanis. The book "International Trade and Transportation Infrastructure Development: Experiences in North America and Europe". Kyiv: Elsevier 2020, 282
4. T. Voichenko, S. Lytvynenko, M. Buhaiova, I. Medvediev, N. Remzina, Y. Popova. "International Transportation" Kyiv: Publishing House "Condor", 2023. 268 p.