NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department _____Design of machines and equipment_____

“ **APPROVED** ”
the Faculty Construction and Design
“___” _____ 2025 p.

CURRICULUM OF ACADEMIC DISCIPLINE

MACHINE ELEMENTS, HOISTING AND CONVEYING MACHINERY

Field of knowledge: 13 – Mechanical engineering
Specialty: 133 – Industrial Mechanical Engineering
Academic programme _: Industrial Mechanical Engineering
Faculty of Construction and Design
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Kyiv – 2025 y.

Description of the discipline

MACHINE ELEMENTS, HOISTING AND CONVEYING MACHINERY

(назва)

This discipline covers the fundamental principles, design, and operation of machine elements and equipment used in hoisting and conveying systems. Students study the classification, structure, and functions of mechanical components such as gears, shafts, bearings, couplings, and brakes, with a focus on their application in agricultural machines, lifting and transport mechanisms. Emphasis is placed on understanding the working principles, load calculations, selection criteria, and maintenance of hoisting cranes, elevators, conveyors, and related systems. The course integrates theoretical knowledge with practical tasks to develop skills necessary for designing, analyzing, and operating machinery in industrial and agricultural sectors.

Academic degree, specialty, academic programme	
Academic degree	*Bachelor's*
Specialty	*133 - Industrial Mechanical Engineering*
Academic programme	*Industrial Mechanical Engineering*
Characteristics of the discipline	
Type	Compulsory
Total number of hours	240
Number of ECTS credits	8
Number of modules	6
Course project (work) (if any)	Course project
Form of assessment	*Credit, Exam, Exam*
Indicators of the discipline for full-time and part-time forms of university study	
	Full-time form of study
Year of study	3,4
Semester	5,6,7
Lectures	*75hr.*
Practical classes and seminars	*- hr.*
Laboratory classes	*90hr.*
Self-study	*45hr.*
Number of hours per week for full-time students	*4 hr.* *4 hr.* *3 hr*

1. Aim, competences and expected learning outcomes of the discipline

The aim of discipline is the formation of students' systematic knowledge: using of structural materials, heat treatment, methods of calculation and design of general purpose parts, the application of modern methods of calculating passive gears, the choice of roller bearings, the assembly of kinematic schemes of actuators of agricultural machines, the use of the method of selecting the standard electric motors, reducers, mechanical couplings.

Acquisition of competences:

Integral competence (IC): The ability of a person to solve complex specialized tasks and practical problems in a certain field of professional activity or in the learning process, which involves the application of certain theories and methods of the relevant sciences and is characterized by the complexity and uncertainty of conditions.

General competences (GC): GC 2. Ability to apply knowledge in practical situations.

GC 5.Ability to generate new ideas (creativity).

GC 6.The ability to conduct research at a certain level.

GC 8.The ability to act socially responsibly and consciously.

GC 10.Have skills in using information and communication technologies.

GC 12.The ability to realize one's rights and responsibilities as a member of society, to be aware of the values of a civil (free democratic) society and the need for its sustainable development, the rule of law, the rights and freedoms of a person and a citizen in Ukraine.

GC 13.The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on an understanding of the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technologies, to use various types and forms of motor activity for active recreation and leading a healthy lifestyle.

Special (professional) competences (SC): PC 1. Ability to apply typical analytical methods and computer software tools for solving engineering problems of industrial mechanical engineering, effective quantitative methods of mathematics, physics, engineering sciences, as well as appropriate computer software for solving engineering problems of industrial mechanical engineering.

PC 5.Ability to use computerized design systems and specialized application software to solve engineering tasks in the field of mechanical engineering.

PC 6.The ability to evaluate the technical and economic efficiency of typical systems and their components based on the application of analytical methods, analysis of analogues and the use of available data.

PC 7.The ability to make effective decisions regarding the selection of construction materials, equipment, processes and to combine theory and practice to solve an engineering task.

PC 9.The ability to carry out commercial and economic activities in the field of mechanical engineering.

PC 10.The ability to develop plans and projects in the field of mechanical engineering under uncertain conditions, aimed at achieving the goal, taking into account existing limitations, to solve complex problems and practical problems of improving product quality and its control.

Expected Learning Outcomes (ELO): ELO 1. Knowledge and understanding of the basics of technological, fundamental and engineering sciences, which are the basis of industrial mechanical engineering in the relevant field.

ELO 2.Knowledge and understanding of mechanics and mechanical engineering and their development prospects.

ELO 4.Carry out engineering calculations to solve complex problems and practical problems in industrial mechanical engineering.

ELO 7.Prepare production and operate products using automatic life cycle support systems.

ELO 10.To understand the problems of labor protection and legal aspects of engineering activity in industrial mechanical engineering, the skills of forecasting the social and environmental consequences of the implementation of technical tasks.

ELO 11.Communicate freely with the engineering community orally and in writing in national and foreign languages.

ELO 12.Apply means of technical control to evaluate the parameters of objects and processes in industrial mechanical engineering.

ELO 14.Develop machine parts and assemblies using automated design systems.

2. Program and structure of the course for:

Modules and topics	Number of hours						
	full-time						
	weeks	total	including				
			l	p	lab	ind	s.st
1	2	3	4	5	6	7	8
5-th semester Module 1. Transmissions. Part I.							
Theme 1. Introduction: What is Machine Design?	1-2	10	4	-	4	-	2
Theme 2. Transmission Mechanism. Gear.	3-4	10	4	-	4	-	2
Theme 3. Gear Failure	5-6	10	4	-	4	-	2
Theme 4. Involute Spur Gears	7	5	2	-	2	-	1
Total for module 1	35		14	-	14	-	7
Module 2. Transmission. Part II.							
Theme 1. Calculation of spur gear	8-9	10	4	-	4	-	2
Theme 2. Helical Spur Gear	10-11	10	4	-	4	-	2
Theme 3. Bevel Gear	12-13	10	4	-	4	-	2
Theme 4. Worm Gearing	14-15	10	4	-	4	-	2
Total for module 2	40		16	-	16	-	8
Total for 5-th semester	75		30	-	30		15
6-th semester Module 3. Drives. Shafts and bearings							
Theme 1. Chain transmissions	1-2	10	4	-	4	-	2
Theme 2. Belt transmissions.	3-4	10	4	-	4	-	2
Theme 3. Shafts and axles.	5-6	10	4	-	4	-	2
Theme 4. Sliding and rolling bearings.	7-8	10	4	-	4	-	2
Total for module 3	40		16	-	16	-	8

Module 4. Couplings, springs, designing of reducers							
Theme 1. The combination of machine elements. Riveting couplings	9-10	10	4	-	4	-	2
Theme 2. Combining elements with tension	11-12	10	4	-	4	-	2
Theme 3. Slicing joints	13-14	10	4	-	4	-	2
Theme 4. Seals, lubricants and devices	15	5	2	-	2	-	1
Total for module 4	35		14	-	14	-	7
Total for 6-th semester	75		30	-	30	-	15
7-th semester Module 5. Conveying machines							
Theme 1. Introduction. Characteristics of lifting and conveying machines	1	1	1	-		-	
Theme 2. Belt conveyors	1-3	12	2	-	6	-	4
Theme 3. Bucket conveyors	4-5	8	2	-	6	-	
Theme 4. Chain Conveyors	6	1	1	-		-	
Theme 5. ScrewConveyors	7-8	9	1	-	4	-	4
Total for module 5	31		7		16		8
Module 6. Hoisting machines							
Theme 1. Overhead cranes	9-10	6	2	-		-	4
Theme 2. Tower cranes and Derricks	10	2	2	-		-	
Theme 3. Ropes, Blocks-and-Tackles	11-12	8	2	-	6	-	
Theme 4. Load-Handling Devices	13-14	5	1	-	4	-	
Theme 5. Hoists and Winches	14-15	8	1	-	4		3
Total for module 6	29		8		14		7
Total for 7-th semester	60		15		30		15
Course project	30		-	-	-	30	-
Total hours	240		75		90	30	45

3. Topics of lectures

№ з/п	Назва теми	Кількість годин
1.	Introduction: What is Machine Design?	4
2.	Transmission Mechanism. Gear.	4
3.	Gear Failure	4
4.	Involute Spur Gears	2
5.	Calculation of spur gear	4
6.	Helical Spur Gear	4
7.	Bevel Gear	4
8.	Worm Gearing	4

9.	Chain transmissions	4
10.	Belt transmissions.	4
11.	Shafts and axles.	4
12.	Sliding and rolling bearings.	4
13.	The combination of machine elements. Riveting couplings	4
14.	Combining elements with tension	4
15.	Slicing joints	4
16.	Seals, lubricants and devices	2
17.	Introduction. Characteristics of lifting and conveying machines	1
18.	Belt conveyors	2
19.	Bucket conveyors	2
20.	Chain Conveyors	1
21.	Screw Conveyors	1
22.	Overhead cranes	2
23.	Tower cranes and Derricks	2
24.	Ropes, Blocks-and-Tackles	2
25.	Load-Handling Devices	1
26.	Hoists and Winches	1

4. Topics of laboratory (practical, seminar) classes

№	Topic title	Hours
1.	Kinematic scheme	5
2.	Kinematic calculation of a drive	5
3.	Studying and parameter calculation of a spur-gear reducer	5
4.	Studying and parameter calculation of a bevel-gear reducer	5
5.	Studying and parameter calculation of a worm-gear reducer	5
6.	Studying of ball and roller bearings	5
7.	Research of the shaft resonance	6
8.	Research of roller bearings	6
9.	Study of the assembly procedure of specification listing	6
10.	Investigation of the influence of parameters that affect the coefficient of friction in the thread**.**	6
11.	Determine the coefficient of friction on the compression surface of the screw connection stress, which is determined depending on the following main factors:	6
12.	Belt Conveyor	6
13.	Screw Conveyor	6
14.	Bucket Conveyor	4
15.	Ropes, Block-And-Tackles	6
16.	Telpher	4
17.	Jacks	4

5. Topics of self-study

№	Topic title	Hours
1	Kinematic analysis of a mechanical drive	4
2	Calculation of opened gears and drives	4
3	Selecting couplings	3
4	Assembly drawing of subshaft	5
5	Selecting bearings	3
6	Selecting keys	2
7	Calculation of shaft by equivalent moment	3
8	Assembly drawing of drive	6
9	Determination of the force in the belt (method of bypassing the contour). Calculation of the power of the conveyor drive.	3
10	Types of the screws and their operation. Calculation of the power of the conveyor drive.	4
11	Calculation of power of a hoist and trolley. Selection of the drive (motor, reducer, couplings)	4
12	Hydraulic and screw jacks operation. Force analysis. Selection and calculation. Advantages and drawbacks	4

6. Tools for assessing expected learning outcomes:

- exam;
- credit;
- module tests;
- graphic design works;
- presentation of laboratory and practical works.

7. Teaching methods

In teaching this discipline, the following methods are used: problem-based learning; practice-oriented learning; research-based learning; method of educational discussions and debates; teamwork and brainstorming.

8. Distribution of points received by students

The assessment of students' knowledge and skills is conducted by means of a 100-point scale and is converted into national grades according to the current *Exam and Credit Regulations at NULES of Ukraine*.

8.1 Distribution of points by type of learning activity

Type of learning activity	Education Results	Estimation
5-th semester		
Module 1. Transmissions. Part I.		
Lab 1. Kinematic scheme	ELO 1, 2, 4, 7, 10, 11, 12, 14. As a result of completing the laboratory and self-study assignments, students have	10
Lab 2. Kinematic calculation of a drive		10

Lab 3. Studying and parameter calculation of a spur-gear reducer	developed a clear understanding of the kinematic structure and functioning of mechanical drive systems. They gained knowledge and practical skills related to constructing kinematic schemes, performing kinematic calculations, and analyzing the movement and transmission of mechanical energy through gear systems. Special attention was given to the study and parameter calculation of spur-gear reducers, as well as the evaluation of open gear drives. These tasks contributed to the formation of strong foundational competencies in mechanical drive analysis, supporting the students' ability to design, assess, and apply transmission mechanisms in engineering practice.	10
Self-study 1. Kinematic analysis of a mechanical drive		25
Self-study 2. Calculation of opened gears and drives		25
Test to the module 1		20
Total for 1 module	-	100
Module 2. Transmission. Part II.		
Lab 4. Studying and parameter calculation of a bevel-gear reducer	ELO 1, 2, 4, 7, 10, 11, 12, 14. As a result of completing these laboratory and self-study assignments, students have expanded their understanding of complex mechanical components and assemblies used in power transmission systems. They acquired practical and theoretical knowledge in the study and parameter calculation of bevel-gear and worm-gear reducers, as well as in the selection and application of ball and roller bearings. Additionally, students improved their ability to select appropriate couplings for various mechanical systems and gained experience in creating detailed assembly drawings of subshaft units. These activities have significantly enhanced their technical proficiency, design capabilities, and readiness for solving practical engineering problems related to machine components and assemblies.	10
Lab 5. Studying and parameter calculation of a worm-gear reducer		10
Lab 6. Studying of ball and roller bearings		10
Self-study 3. Selecting couplings		25
Self-study 4. Assembly drawing of subshaft		25
Test to the module 2		20
Total for 2 module	-	100
Educational work	-	(M1+M2)/2*0,7 ≤70
Final Test	-	30
Overall Score	-	(Educational work + Final Test)≤100
6-th semester		
Module 3. Drives. Shafts and bearings.		
Lab 7. Research of the shaft resonance	ELO 1, 2, 4, 7, 10, 11, 12, 14. As a result of completing these laboratory	10

Lab 8. Research of roller bearings	and self-study tasks, students have strengthened their understanding of the dynamic behavior and structural elements of mechanical systems. They gained knowledge and practical skills in researching shaft resonance phenomena and investigating the operational characteristics of roller bearings. Additionally, students studied the procedures for preparing assembly specifications and developed competencies in selecting appropriate bearings and keys for various mechanical applications. These activities contributed to the development of analytical thinking, precision in technical documentation, and the ability to make informed engineering decisions in the design and maintenance of mechanical systems.	10
Lab 9. Study of the assembly procedure of specification listing		10
Self-study 5. Selecting bearings		25
Self-study 6. Selecting keys		25
Test to the module 3		20
Total for 3 module	-	100
Module 4. Couplings, springs, designing of reducers		
Lab 10. Investigation of the influence of parameters that affect the coefficient of friction in the thread**.**	ELO 1, 2, 4, 7, 10, 11, 12, 14. As a result of completing these laboratory and self-study assignments, students have deepened their understanding of frictional interactions and stress distribution in threaded and screw connections. They investigated the influence of various parameters on the coefficient of friction in threads and on compression surfaces, gaining insights into how these factors affect the reliability and performance of mechanical joints. Additionally, students developed skills in calculating shafts using the equivalent moment method and in preparing precise assembly drawings of drive systems. These tasks enhanced their ability to evaluate mechanical strength, ensure structural integrity, and create accurate technical documentation essential for mechanical design and analysis.	15
Lab 11. Determine the coefficient of friction on the compression surface of the screw connection stress, which is determined depending on the following main factors:		15
Self-study 7. Calculation of shaft by equivalent moment		25
Self-study 8. Assembly drawing of drive		25
Test to the module 4		20
Total for 4 module	-	100
Educational work	-	(M1+M2)/2*0,7 ≤70
Examination	-	30
Overall Score	-	(Educational work + Final Test)≤100
7-th semester		
Module 5. Conveying machines		
Lab 12. Belt Conveyor	ELO 1, 2, 4, 7, 10, 11, 12, 14. Know: cargo characteristics; productivity of	10
Lab 13. Screw Conveyor		10

Lab 14. Bucket Conveyor	transporting machines; productivity of transporting machines for bulk and piece cargoes; operating modes of mechanical transporting machines; methods of calculating conveyors with flexible traction elements; components of chain and belt conveyors; classification and design and types of screws. Be able to:select the width of the belt conveyor belt; perform traction calculation; perform the calculation of the strength tape; perform performance, power and torque on the screw.	10
Self-study 9. Determination of the force in the belt (method of bypassing the contour). Calculation of the power of the conveyor drive.		15
Self-study 10. Types of the screws and their operation. Calculation of the power of the conveyor drive.		15
Test to the module 5		40
Total for 5 module	-	100
Module 6. Hoisting machines		
Lab 15. Ropes, Block-And-Tackles	ELO 1, 2, 4, 7, 10, 11, 12, 14. Know: the general classification and basic parameters of hoisting machines; design, calculation of strength and durability, norms of rejection of steel ropes; calculation of the load on the axis of the block; calculation of the diameter and length of the axis); purpose and multiplicity of direct and reverse pulleys, single and double. Be able to:determine the performance of lifting machines and their modes of operation (groups of modes of operation of lifting mechanisms and cranes and their components)..	10
Lab 16. Telpher		10
Lab 17. Jacks		10
Self-study 11. Calculation of power of a hoist and trolley. Selection of the drive (motor, reducer, couplings)		15
Self-study 12. Hydraulic and screw jacks operation. Force analysis. Selection and calculation. Advantages and drawbacks		15
Test to the module 6		40
Total for 6 module	-	100
Educational work	-	(M1+M2)/2*0,7 ≤70
Final Test	-	30
Overall Score	-	(Educational work + Final Test)≤100
Course project	-	100

8.2 Scale for assessing the knowledge of a higher education student

Student's rating, points	National grading of exams and credits
	exams
90-100	excellent
74-89	good
60-73	satisfactorily
0-59	unsatisfactorily

8.3 Grading Policy

Policy on deadlines and retakes:	work that is submitted late without valid reasons will be assessed with a lower grade. Rescheduling of modules takes place with the permission of the lecturer if there are valid reasons (e.g., sick

	leave).
Academic integrity policy:	cheating during tests and exams is prohibited (including using mobile devices). All papers and abstracts must have correct textual references to the literature used
Attendance policy:	attendance is mandatory. For objective reasons (e.g., illness, international internship), training can take place individually (online in agreement with the dean of the faculty)

9. Teaching and learning aids

- e-learning course of the discipline (https://elearn.nubip.edu.ua/enrol/index.php?id=759;

https://elearn.nubip.edu.ua/course/view.php?id=760

https://elearn.nubip.edu.ua/course/view.php?id=3461*)*;

1. Ловейкін В. С., Рибалко В. М., Ромасевич Ю. О., Матухно Н. В., Ляшко А. П. Деталі машин. Друге видання. К.: «Компринт». 2020. 736 с.
2. Ловейкін В. С., Рибалко В. М., Ляшко А. П., Матухно Н. В. Деталі машин. Частина 1. К.: «Компринт». 2023. 580 с.

10. Recommended sources of information

1. Budynas, R. G. Shigley's Mechanical Engineering Design / R. G. Budynas, K. J. Nisbett. – 12th ed. – New York : McGraw-Hill Education, 2023. – 1152 p.
2. Mott, R. L. Machine Elements in Mechanical Design / R. L. Mott, E. M. Vavrek, J. Wang. – 6th ed. – Boston : Pearson, 2018. – 912 p.
3. Norton, R. L. Machine Design: An Integrated Approach / R. L. Norton. – 6th ed. – Boston : Pearson, 2020. – 1056 p.
4. Pilkey, W. D. Peterson's Stress Concentration Factors / W. D. Pilkey, D. F. Pilkey. – 4th ed. – New Jersey : John Wiley & Sons, 2020. – 560 p.
5. Schmid, S. R. Fundamentals of Machine Elements / S. R. Schmid, B. J. Hamrock, B. O. Jacobson. – 4th ed. – Boca Raton : CRC Press, 2021. – 896 p.
6. Mullineux, G. Introduction to Machine Elements / G. Mullineux. – 1st ed. – London : Springer, 2022. – 342 p.
7. Spotts, M. F. Design of Machine Elements / M. F. Spotts, T. E. Shoup, L. E. Hornberger. – 9th ed. – Boston : Pearson, 2019. – 816 p.