Syllabus
educational component

Wear-resistant and anti-friction materials

Subjects:	**Wear-resistant and anti-friction materials**
Level of higher education:	**the first (bachelor's)**
Course page in Moodle :	https://dl2022.khadi-kh.com/course/index.php?categoryid=840
The scope of the educational component	**3 credits (90 hours)**
Final control form	**Test**
Consultations:	**on schedule**
Name of the department:	**department of metal technology and materials science**
Teaching language:	**English**
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Brief content of the educational component:
The goal is study general issues of friction, wear and lubrication of tribo couplings of machines and equipment; acquisition of theoretical knowledge and practical skills necessary for reliable operation of equipment, establishment of causes of wear and ways of increasing their wear resistance.
Subject: basic tribological regularities for solving specific design, technological and operational tasks related to friction, wear and lubrication of machines and mechanisms, as well as purposeful selection of materials with the necessary physical and mechanical properties, taking into account their operating conditions.

The main tasks of studying an academic discipline are:
As a result of studying the academic discipline, the student should know:
– the basic laws of friction and wear of materials;
– laws of interaction of friction surfaces and lubrication regimes;
– the principle of choosing materials in the tribosystem taking into account the maximum resource at the stage of design and operation of machines and equipment. be able to:
– determine friction losses, friction coefficient in real structures of tribosystems when designing new models of equipment;
– determine the rate of wear and calculate the resource of tribosystems;
– analyze the designs of friction nodes and select lubricants for their operation;
– to develop technological processes of defects and ongoing repair of equipment.

Prerequisites for studying the educational component:
Physics. Chemistry. Construction materials technology and materials science. Materials science.

Competencies acquired by the acquirer:
General competences:
Ability to speak and write in native language.
Ability to act on the basis of legal and ethical judgments.
Ability to find and use information from domestic and other sources earthly sources.
Knowledge and understanding of one's specialty.

Special (professional) competences:
The ability to use modern information and communication technologies professional activities in the field of materials science and materials technology.
The ability to use in practice modern ideas about the influence of micro-, macro- and nanostructure on the properties of materials, their interaction with the environment.
The ability to perform a literary search of sources, including foreign ones professional field and use them in their professional activities.
Knowledge of patterns of phase transformations in metals and alloys.
Knowledge of the main groups of materials and the ability to reasonably implement them selection for specific operating conditions.

Learning outcomes according to the educational program:
To know the basics of the elements of theoretical and experimental research in professional activity. To be able to use the achievements of modern information technologies, to make programs.
Know the main groups of materials and reasonably make their selection for specific operating conditions.
Use experimental methods of studying structural, physical-mechanical, electrophysical, magnetic, optical and technological properties of materials.

Thematic plan

Topic No	Name of topics (LK, LR, PR, SZ, SR)	Number of hours
		ocular
1	LC Topic 1. Tribotechnics and its structure	2
	PR Determination of the resource of tribocouplers	2
	SR Damage from friction and wear and tear in machines	2
2	LC Topic 2. Characteristics of the surface of solid bodies	2
	PR. Molecular-mechanical theory of friction	2
	SR Properties of surfaces and surface layers as a result of technological processing	4
3	LC Physico-chemical properties of friction surfaces	4
	PR Assessment of fault-free operation of non-renewable elements of tribosystems	2
	SR Mutual contact of parts	2
4	LK Theoretical foundations of friction and wear	4
	PR Structural and energetic theory of friction	2
	SR Hardness of metals	4
5	LK Features of friction of tribocoupled materials	4
	PR Study of wear and damage of machine parts	2
	SR Features of friction of fluoroplastic	2
6	LC Types of friction	2
	PR	–
	SR Modes of friction in sliding bearings	4
7	LK Types of wear and damage of friction surfaces	4
	PR Study of the wear of parts by the method of artificial bases	2
	SR Amorphous materials with special properties	2
8	LK Lubricating materials	2
	PR	–
	SR The principle of selecting additives for lubricants	4

9	LC Modes of lubrication	2
	PR Diagnosis of friction nodes	2
	SR Limit mode of lubrication	4
10	LK Tribotechnical materials	6
	PR Methods of increasing the reliability of tribosystems	2
	SR Regenerative mixtures for regeneration of tribo systems	2
11	LC Diagnostics of friction nodes	2
	PR	–
	SR Prospects for the development of wear diagnostics	2
Together	**LK**	**32**
	PR	**16**
	SR	**42**

Individual educational and research task (if available): absent

Teaching methods:
1) verbal:
1.1 traditional: lectures, explanations, stories, etc.;
1.2 interactive (non-traditional): problem lectures, discussions, etc.;
2) visual: method of illustrations, method of demonstrations
3) practical:
3.1 traditional: practical classes, seminars;
3.2 interactive (non-traditional): business and role-playing games, trainings, seminars-discussions, "round table", brainstorming method

System assessment and requirements:

Current performance
1 The current success of applicants for the performance of educational types of work in training sessions and for the performance of independent work tasks is evaluated using a four-point rating scale with subsequent transfer to a 100-point scale. During the evaluation of the current academic performance, all types of work provided for by the educational program are taken into account.
1.1 Lecture classes are evaluated by determining the quality of performance of specified tasks.
1.2 Practical classes are evaluated by the quality of performance of a control or individual task, performance and design of practical work.
1.3 Laboratory classes are evaluated by the quality of reports on the performance of laboratory work.
1.4 Seminar classes are evaluated by the quality of individual assignment/abstract.
2 The current performance of higher education applicants is assessed at each practical session (laboratory or seminar) on a four-point scale ("5", "4", "3", "2") and entered in the journal of academic performance.
– "excellent": the winner mastered the theoretical material flawlessly, demonstrates deep knowledge of the relevant topic or academic discipline, the main provisions;
– "good": the applicant has mastered the theoretical material well, has the main aspects from primary sources and recommended literature, presents it in an argumentative manner; has practical skills, expresses his thoughts on certain problems, but certain inaccuracies and errors are assumed in the logic of the presentation of theoretical content or in the analysis of practical ones;
– "satisfactory": the applicant has basically mastered the theoretical knowledge of the educational topic or discipline, orients himself in primary sources and recommended

literature, but answers unconvincingly, confuses concepts, answers additional questions uncertainly, does not have stable knowledge; when answering questions of a practical nature, reveals inaccuracy in knowledge, does not know how to evaluate facts and phenomena, connect them with the future profession;
– "unsatisfactory": the applicant has not mastered the educational material of the topic (discipline), does not know scientific facts, definitions, hardly orients himself in primary sources and recommended literature, lacks scientific thinking, practical skills are not formed.
3 The final score for the current activity is recognized as the arithmetic mean sum of points for each lesson, for individual work, current test works according to the formula:

$$K^{\text{помоч}} = \frac{K1 + K2 + \ldots + Kn}{n},$$

where $K^{\text{помоч}}$ is the final assessment of success based on the results of current control;

$K1, K2, \ldots, Kn$ – evaluation of the success n of the current control measure;

n – number of ongoing control measures.

O prices are converted into points according to the calculation scale (table 1).

Table 1 – Conversion of the average score for the current activity into a multi-point scale

4-point scale	100 points scale	4-ball scale	100 points scale	4-ball scale	100 points scale	4-ball scale	100 points scale
5	100	4.45	89	3.90	78	3.35	67
4.95	99	4.4	88	3.85	77	3.3	66
4.9	98	4.35	87	3.80	76	3.25	65
4.85	97	4.3	86	3.75	75	3.2	64
4.8	96	4.25	85	3.7	74	3.15	63
4.75	95	4.20	84	3.65	73	3.1	62
4.7	94	4.15	83	3.60	72	3.05	61
4.65	93	4.10	82	3.55	71	3	60
4.6	92	4.05	81	3.5	70	from 1.78 to 2.99	from 35 to 59
						reassembly	
4.55	91	4.00	80	3.45	69	from 0 to 1.77	from 0 to 34
4.5	90	3.95	79	3,4	68	repeated study	

Final assessment
1 A student of higher education receives a credit in the last lesson in the discipline based on the results of the current assessment. The average score for the current activity is converted into points on a 100 -point scale, according to the conversion table (table 1).
Applicants for higher education who have a current grade point average in the discipline lower than "3" (60 points) can increase their current grade by taking tests in the discipline in the last session.
Assessment of the knowledge of applicants through testing is carried out according to the following scale:
– "Excellent": at least 90% of correct answers;
– "Very good": 82% to 89% correct answers;
– "Good": from 74% to 81% of correct answers;
– "Satisfactory": from 67% to 73% of correct answers;
– "Fair enough": 60% to 66% correct answers;
– "Unsatisfactory": less than 60% of correct answers.
2 The condition for obtaining credit is:

– making up for all missed classes;
– the average current grade in the discipline is not lower than "3" (60 points).
3 For performing individual independent work and participation in scientific events, additional points are awarded to the winners.
3.1 Additional points are added to the sum of points scored by the student of higher education for the current educational activity (for disciplines for which the final form of control is a test), or to the final grade in the discipline for which the final form of control is an exam.
3.2 The number of additional points awarded for different types of individual tasks depends on their volume and importance:
– prizes in the discipline at the international / all-Ukrainian competition of scientific student works - 20 points;
– prize places in the discipline at the All-Ukrainian Olympiads - 20 points;
– participation in the international / all-Ukrainian competition of scientific student works - 15 points
– participation in international / all-Ukrainian scientific conferences of students and young scientists - 12 points;
– participation in all-Ukrainian Olympiads in the discipline - 10 points
– participation in olympiads and scientific conferences of the Khnadu in the discipline - 5 points;
– performance of individual scientific and research (educational and research) tasks of increased complexity - 5 points .
3.3 The number of additional points cannot exceed 20 points.
4 The learning result is evaluated *(select the required one)* :
– on a two- point scale (passed/failed) according to table 2;
– for 100 - point scale (for differentiated assessment) according to table 3.
The final grade together with additional points cannot exceed 100 points.

Table 2 – Scale for transferring points to the national evaluation system

On a 100-point scale	**On a national scale**
from 60 points to 100 points	counted
less than 60 points	not counted

Table 3 – The scale for evaluating the knowledge of the students based on the results of the final control of the academic discipline

Score in points	Evaluation on a national scale		Evaluation according to the ECTS scale	
	examination	test	Rating	Criteria
90-100	**Perfectly**	**Enrolled**	**A**	The theoretical content of the course has been mastered in its entirety, without gaps, the necessary practical skills for working with the mastered material have been formed, all educational tasks provided for in the training program have been completed, the quality of their performance has been assessed with a number of points close to the maximum
80–89	**Okay**	**Enrolled**	**B**	The theoretical content of the course has been mastered in its entirety, without gaps, the necessary practical skills for working with the mastered material have mainly been formed, all educational tasks provided for by the training program have been completed, the quality of most of them has been assessed with a number of points close to the maximum
75-79			**C**	The theoretical content of the course has been mastered in its entirety, without gaps, some practical skills of working with the mastered material have not been formed enough, all educational tasks provided for by the training program have been completed, the quality of none of them has been assessed with a minimum number of points, some types of tasks have been completed with errors
67-74	**Satisfactorily**		**D**	The theoretical content of the course is partially mastered, but the gaps are not of a significant nature, the necessary practical skills for working with the mastered material are basically formed, most of the educational tasks provided by the training program have been completed, some of the completed tasks may contain errors
60–66			**E**	The theoretical content of the course has been partially mastered, some practical work skills have not been formed, many educational tasks provided by the training program have not been completed, or the quality of some of them has been assessed with a number of points close to the minimum.

Score in points	Evaluation on a national scale		Evaluation according to the ECTS scale	
	examination	test	Rating	Criteria
35–59	**Unsatisfactorily**	**Not counted**	**FX**	The theoretical content of the course has been partially mastered, the necessary practical work skills have not been formed, most of the prescribed training programs of educational tasks have not been completed, or the quality of their implementation has been assessed with a number of points close to the minimum; with additional independent work on the course material, it is possible to improve the quality of the performance of educational tasks (with the possibility of retaking)
0–34	**Unacceptable**		**F**	The theoretical content of the course has not been mastered, the necessary practical work skills have not been formed, all completed educational tasks contain gross errors, additional independent work on the course material will not lead to any significant improvement in the quality of the performance of educational tasks (with a mandatory repeat course)

Course policy:

– the course involves working in a team, the environment in the classroom is friendly, creative, open to constructive criticism;

– mastering the discipline involves mandatory attendance of lectures and practical classes, as well as independent work;

– independent work involves the study of individual topics of the academic discipline, which are presented in accordance with the program for independent study, or were considered briefly;

– all tasks provided by the program must be completed within the set time;

– if the student of higher education is absent from classes for a good reason, he presents the completed tasks during independent preparation and consultation of the teacher;

– while studying the course, students of higher education must comply with the rules of academic integrity set forth in the following documents: "Rules of academic integrity of participants in the educational process of the Khnadu" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_dobroch_1.pdf), "Academic integrity. Checking the text of completed academic papers and works for plagiarism" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_85_1_01.pdf), "Moral and ethical code of participants in the educational process of the National Academy of Sciences of Ukraine (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_MEK_1.pdf).

– in case of detection of plagiarism, the applicant receives 0 points for the task and must repeat the tasks provided for in the syllabus;

– writing off lectures or practical works, using other people's educational materials (including using mobile devices) is prohibited. Mobile devices are allowed to be used only during online checking of practical task results, additional testing.

Recommended Books:

1. Basic literature

1.1. Antypenko A.M. ta in. Osnovy trybolohii / A.M. Antypenko, O.M. Bielas, V.A. Voitov, O.S. Votchenko – Kharkiv : KhNTUSH, 2008. – 342 s.
1.2. Zakalov O.V. Osnovy tertia i znoshuvannia v mashynakh / O.V. Zakalov, I.O. Zakalov – Ternopil: TNTU im. I. Puliuia, 2011. – 322 s.

Developer(s) syllabus of the educational discipline	_____ signature	Yu.V. Ryzhkov name
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