

**Syllabus**  
**educational component of selective component**  
(reference designation of educational component in educational program  
(educational program))

**Protective coatings in mechanical engineering**

Course title:	<b>Protective coatings in mechanical engineering</b>
Level of high education:	<b>the second (master's)</b>
Course link in Moodle:	<a href="https://dl2022.khadi-kh.com/course/index.php?categoryid=840">https://dl2022.khadi-kh.com/course/index.php?categoryid=840</a>
The volume of educational component:	<b>3 credits (90 hours)</b>
Final assessment:	<a href="https://dl2022.khadi-kh.com/">https://dl2022.khadi-kh.com/</a>
Consultations:	<b>Not provided according the curriculum</b>
Name of the department:	<b>Technologies of metals and materials science</b>
Language of teaching:	<b>Ukrainian</b>
Course leader:	<b>Ryzhkov Yuriy Volodymyrovych, Ph.D. in Technical Sciences, Associate professor</b>
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**Summary of the educational component:**

**The aim is** to study the physico-chemical processes, mechanisms and regularities that are responsible for the creation of a surface with the basic methods of its modification, doping and coating

**Subject:** the choice of surface treatment technology for machine parts to increase their wear resistance, surface strength and operational reliability.

**The main objectives of studying an academic discipline are:**

Be able to prescribe and know the basic methods of applying protective coatings and surface modification methods. Successfully use knowledge of surface modification to accelerate diffusion processes during coating application.

**Prerequisites for studying the educational component:**

the discipline is studied after

studying the disciplines "Physics", "Materials Science", "Technology of construction materials and materials science", "Physical foundations, devices and methods of modern materials science".

**Competencies gained by the applicant:**

**General competencies:**

The ability to generate new ideas and implement them in the form of valid innovative solutions.

The ability to find, process and analyze information from various sources.

Ability and readiness to implement modern technological processes of obtaining and processing materials and technologies for improving properties and restoring products in order to meet their production requirements.

**Special (professional) competences:**

The ability to perform scientific research, analyze and process the results of natural or model experiments, using regulatory documents, new hypotheses in the field of materials science, information technologies, software.

The ability to perform a literature search of sources in the professional field and critically evaluate published materials.

Specialized knowledge of the latest methods and techniques of modeling, development and research of materials.

The knowledge of the main groups of materials and the ability to justify their selection for specific operating conditions.

**Learning outcomes according to the educational program is:**

to know the main groups of materials and reasonably make their selection for specific operating conditions.

to use experimental methods of studying structural, physical-mechanical, electrophysical, magnetic, optical and technological properties of materials.

to apply knowledge and understanding of experimental design methods, perform experimental studies and process their results.

**Thematic Plan**

№ topic	Topics (Lecture (L.), laboratory class (LC), Practicals (P), self-study (SS), self-guided work (SGW))	Number of hours
		ocular
1	L. Introduction. Surface engineering and development of modern mechanical engineering	2
	P.(LC, SS) Methods of applying wear-resistant coatings to tool	2
	SGW Processing of information support for each module (topic)	6
2	L. Surface physical and chemical processes during application coatings	2
	P. (LC, SS) Methods of applying wear-resistant coatings to cutting tools	2
	SGW Processing of information support for each module (topic)	6
3	LC Structure and properties of coatings	2
	P (LC, SS) Technology of thermal and vacuum spraying	2
	SGW Processing of information support for each module (topic)	6
4	LC Technological foundations of surface engineering and basic coating methods	4
	P (LC, SS) Technology of thermal and vacuum spraying	2
	CGW Processing of information support for each module (topic)	8
5	L Modification of the surface of parts of machines and mechanisms	2
	P (LC, SS) Thermal oxidation technology	2
	SGW Processing of information support for each module (topic)	8
6	L Principles of choosing coating material and modified layers	2
	P (LC, SS) Determining the adhesion strength of the coating to the base	2
	SGW Processing of information support for each module (topic)	8
7	L Surface engineering of parts at the stages of the life cycle.	2
	P (LC, SS) Electrospark alloying technology	2
	SGW Processing of information support for each module (topic)	8
8	L -	-
	P (LC, SS) Electrospark alloying technology	2
	SGW Preparation for the final assessment	8

<b>Together</b>	L	16
	P (LC, SS)	16
	SGW	58

**Individual educational and research task (if available):** absent

### Teaching methods:

- 1) oral: 1.1 traditional: lectures, explanation, telling etc;  
1.2 non-traditional :electronic option, remote.
- 2) visual: illustration method, demonstration method
- 3) practical: 3.1 traditional practical lessons  
3.2 no-traditional remote

### 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:

$$K^{nomoy} = \frac{K1 + K2 + \dots + Kn}{n},$$

where  $K^{nomou}$  is the final assessment of success based on the results of current control;  
 $K1, K2, \dots, Kn$  – 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
<b>90-100</b>	<b>Perfectly</b>	<b>Enrolled</b>	<b>A</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 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
<b>80-89</b>	<b>Okay</b>	<b>Enrolled</b>	<b>B</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

Score in points	Evaluation on a national scale		Evaluation according to the ECTS scale	
	examination	test	Rating	Criteria
<b>75-79</b>	<b>Satisfactorily</b>		<b>C</b>	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
<b>67-74</b>			<b>D</b>	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
<b>60-66</b>			<b>E</b>	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.
<b>35-59</b>	<b>Unsatisfactorily</b>	<b>Not counted</b>	<b>FX</b>	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)
<b>0-34</b>	<b>Unacceptable</b>		<b>F</b>	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;
- the coursework must be protected no later than a week before the beginning of the examination session (**indicated if available**) ;
- 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](https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_dobroch_1.pdf)), "Academic integrity. Checking the text of academic, scientific and qualification papers for plagiarism" ([https://www.khadi.kharkov.ua/fileadmin/P\\_Standart/pologeniya/stvnz\\_85\\_1\\_01.pdf](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 Khnadu" ([https://www.khadi.kharkov.ua/fileadmin/P\\_Standart/pologeniya/stvnz\\_67\\_01\\_MEK\\_1.pdf](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 during tests and exams is prohibited (including using mobile devices). Mobile devices are allowed to be used only during online testing.

## Recommended literature:

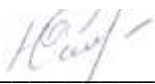
### 1. Basic literature

1. Dmytrychenko M.V. Tribotechnics and the basics of machine reliability: [educat. manual]/ M.V. Dmytrychenko, R.G. Mnatsakanov, O.O. Mykosyanchyk. – K.: Informavtodor, 2006.-216 p.
2. Coating: [educat. manual] / under the editorship acad. NASU K.A. Yushchenko – 2-nd edition – K.: Arista, 2006.- 204 p.
3. N. V. Podoprygora, M. I. Sadovy, O. M. Trifonova. Physics of a solid state: educational manual. Kirovohrad: PE «Center for operational polygraphy «Avangard», 2014. 416 p.
4. H. V. Pokhmurska, M. M. Student, V. I. Pokhmurskyi. Gas thermal coatings: educational manual. Lviv, 2017. 180 p.

### 2 Additional literature

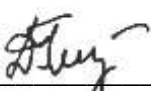
1. Shilina O. P., Osadchuk A. Yu. Gas-thermal coating spraying methods. Educational manual. Vinnytsia: VNTU, 2006. 103 p.
2. Dubovy O.M., Stepanchuk A.M. Technology of spraying coatings Manual. Mykolayiv: National University of Shipbuilding, 2007. 236 p.

Developer(s)  
syllabus of the educational  
discipline

  
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