

Syllabus
selective component of VC
(conditional designation OK in the educational program (OP))

Examination of the structure

Subjects:	Examination of the structure
Level of higher education:	the second (master's)
Course page in Moodle :	<i>https://dl2022.khadi.kharkov.ua/course/view.php?id=1620#section-0</i>
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:	Ukrainian
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Brief content of the educational component:

The goal is to acquire knowledge about the peculiarities of the processes of structure formation and their influence on the complex of mechanical properties and the level of stresses, to determine the possible types of defects that occur in the metal of products depending on the type and mode of their processing or on the conditions of operation, to get acquainted with the methods of studying the structure and properties metal products to determine the quality of metal products and the causes of defects that affect the operational stability of machines and units.

Such knowledge is necessary for creating new parameters of modes and technologies for processing metal products or adjusting existing ones, which can be used to manufacture competitive products.

Subject: theoretical and methodological foundations, methodological provisions of scientific processes of structure formation and their influence on the complex of mechanical properties.

The main tasks of studying an academic discipline are knowledge:

- the sequence of actions during the assessment of the technical condition of the metal product and the analysis of the technical documentation, which regulates its production and operating conditions;
- theoretical foundations of the processes of structure formation in the metal of products and their features in the implementation of various types of thermal or combined treatments;
- the main parameters of modes, technologies of thermal and combined processing of iron-carbon products and their influence on the structure and properties of the metal, as well as on the level of stress, grooving and deformation of the products;
- the main reasons that can lead to the appearance of defects in the metal of the products (thermal gradient across the cross-section of the metal product during its processing, high

stress level, gouging, deformation, flakes, cracks, and others), which can create conditions for violation of operating conditions and affect operational stability of parts and machines;

- methods of quality control of metal products (structure, properties, geometry, etc.), including the material of the surface layer of metal products after surface treatments, which are necessary for detecting metal defects and explaining the reasons for their formation, which is necessary for creating new parameters of regimes or technologies for processing metal products or adjusting existing ones, which can be used to manufacture competitive products;
- the main technological methods of increasing operational stability and reliability of machine parts in the process of their production and structural and technological characteristics of equipment for their implementation in industry;
- theoretical foundations of the processes of structure formation in the materials of the surface layers of parts made of iron-carbon alloys during their rapid and ultra-rapid heating and cooling, physical possibilities of combined treatments in terms of targeted impact on the surface layer of parts and obtaining a standardized set of properties in it;
- wear-resistant materials and rational modes of processing parts from them to ensure the required structural condition and properties.

Prerequisites for studying the educational component:

- "Construction materials technology and materials science";
- "Fundamentals of metallography and structural analysis of materials";
- "Theoretical foundations and equipment of heat treatment";
- "Non-ferrous metals and alloys";
- "Structural strength and methods of increasing it"
- "Scientific research work of students".
- "Modern methods of non-destructive testing".

Competencies acquired by the acquirer:

General competences :

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 apply the acquired knowledge about modern achievements in the subject area.

The ability to evaluate the technical and economic efficiency of research, technological processes and innovative developments, taking into account the uncertainty of conditions and requirements.

The ability to apply a systematic approach to solving applied problems in production conditions.

The ability to apply modern methods and experimental techniques in laboratory and production conditions, the ability to use research and testing equipment to solve problems in the field of materials science.

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 technology, software.

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

Knowledge of the basics of research work, standardization, certification and accreditation of materials and products.

Learning outcomes according to the educational program:

To know and understand the fundamental sciences underlying the relevant block of the "Materials Science" specialty at the level necessary to achieve the results of the educational program.

Know the basics of elements of theoretical and experimental research in professional activity. To be able to use the achievements of modern information technologies, to make programs.

To know and understand measures to restore and ensure high operational properties of machine parts, welded joints and various structures.

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

Use new methods and methods of researching materials and their processing processes based on knowledge of the methodology of scientific research and the specifics of the problem to be solved, correctly interpret the results of research and draw conclusions.

Thematic plan

Topic No	Name of topics (LK, LR, PR, SZ, SR)	Number of hours
		ocular
1	LK INTRODUCTION. Documentation of an expert opinion. Grounds for examination	2
	PR (LR, SZ) STUDY OF THE GRAIN STRUCTURE OF METALLIC MATERIALS	2
	SR Name the groups of metallic materials that differ in grain size	6
2	LK Methods used in material science / metallurgical examination	2
	PR (LR, SZ) DETERMINATION OF THE VOLUME FRACTION OF A PHASE OR STRUCTURAL COMPONENT IN AN ALLOY.	2
	SR What parameters characterize the granular structure of metal materials?	6
3	LC Basics of facsimile photography	2
	PR (LR, SZ) DETERMINATION OF CARBON CONTENT IN STEEL METHOD OF QUANTITATIVE METALLOGRAPHY	2
	SR Name the methods of evaluating the structure of metals and alloys	6
4	LK Methods of investigating the quality of welded Connections	2
	PR (LR, SZ.) DETERMINATION OF CARBON CONTENT IN STEEL METHOD OF QUANTITATIVE METALLOGRAPHY	2
	SR Describe the linear method of determining the volume content of structural constituent alloys	8
5	LK Fundamentals of the method of determining the causes of the destruction of parts	2
	PR (LR, SZ) DEFECTS OF IRON AND STEEL CASTINGS	2
	SR Describe the point method of determining the volumetric content of the structural component of alloys	8
6	LK Fundamentals of the method of determining the causes of the destruction of parts	2

	PR (LR, SZ) DEFECTS OF IRON AND STEEL CASTINGS	2
	SR What measures exist to prevent the occurrence of defects in cast iron and steel castings	8
7	LC Determination of the causes of the formation of cracks in metal by microstructure.	2
	PR (LR, SZ) DEFECTS OF SURFACE METAL PRODUCTS	2
	SR What are the causes that lead to defects in metal products?	8
8	LC Determination of the causes of the formation of cracks in metal by microstructure.	2
	PR (LR, SZ) DEFECTS OF SURFACE METAL PRODUCTS	2
	SR What are the measures that prevent the occurrence of defects in metal products?	8
Together	LK	16
	PR (LR, SZ)	16
	SR	58

Individual educational and research task (if available):

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.

Evaluation system 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:

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

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
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;
- 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), "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), "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).
- 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: (*literature no later than 10 years old, except for 1 fundamental classical textbook or monograph*)

1. DSTU 8972:2019. Steels and alloys. Methods of detection and determination of grain size [Text]. – Valid from 2021-01-01. – Kyiv: UkrNDNC, 2021. – III, 30 p.
2. E. G. Aftandilyants Materials science [Electronic resource]: textbook / E. G. Aftandilyants, O. V. Zazimko, K. G. Lopatko. - Kyiv: Higher Education, 2012. - 548 p.
3. Engineering materials science [Electronic resource]: textbook / Dubovy O. M., Kazymirenko Yu. O., Lebedeva N. Yu. and others. - Mykolaiv: NUK, 2009. - 444 p.
4. <https://en.ppt-online.org/252818>
5. <https://promlab.pro/service.html?itemid=30>
6. http://www.nrcki.ru/files/pdf/Diss_VAU.pdf
7. <https://studfile.net/preview/4300432/#4300432>
8. <https://www.booksite.ru/fulltext/1/001/008/106/929.htm>
9. Product quality control in mechanical engineering [Electronic resource]: training. manual / Fedorov G. E., Yamshinskyi M. M., Fesenko A. M. and others. – Kramatorsk: DDMA, 2008. – 352 p. - Electron. copy text. data – Access mode: <https://foundry.kpi.ua/wp-content/uploads/2020/05/fedorov-gye-kontrol-yakosti-produkcyiy-v-mashynobuduvanni.pdf>
10. Rental of ferrous metals. Terms and definition of surface defects: DSTU 2658-94 [Text]. – [Enter into force 01.07.1995]. – To replace GOST 21014-88. - Kyiv: State Standard of Ukraine, 1995. - (National standard

Developer(s)
syllabus of the educational
discipline


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