



# Equipment manufacturing technology

## Working program of the academic discipline ( Syllabus )

### Details of the academic discipline

Level of higher education	<i>First (undergraduate)</i>
Branch of knowledge	<i>13 "Mechanical engineering"</i>
Specialty	<i>133 Industrial engineering</i>
Educational program	<i>Computer-integrated technologies of chemical engineering equipment design</i>
Discipline status	<i>selective</i>
Form of education	<i>daytime</i>
Year of training, semester	<i>3rd year, autumn semester</i>
Scope of the discipline	<i>4 ECTS credits / 120 hours</i>
Semester control/ control measures	<i>assessment, modular control work, calculation work</i>
Lessons schedule	<i>3 hours per week (1 hour of lectures and 2 hours of practical classes)</i>
Language of teaching	<i>Ukrainian</i>
Information about the head of the course / teachers	<b>Lecturer:</b> associate professor of the Department of the National Academy of Sciences of the Russian Academy of Sciences, candidate of technical sciences Novokhat Oleg Anatoliyovych, e-mail : novokhatoleh @ gmail . com , telegram: @Novokhat_Oleh <b>Practical:</b> associate professor of the Department of the National Academy of Sciences, candidate of technical sciences , Novokhat Oleg Anatoliyovych, email : novokhatoleh@gmail.com, telegram: @Novokhat_Oleh
Placement of the course	<i><a href="https://ci.kpi.ua/uk/silabus-2022-2023/">https://ci.kpi.ua/uk/silabus-2022-2023/</a></i>

### Program of educational discipline

#### 1. Description of the educational discipline, its purpose, subject of study and learning outcomes

##### 1.1. The purpose of the educational discipline

The purpose of the credit module is to form students' abilities to :

- the ability to develop a technological process for the manufacture of apparatus for chemical production;
- the ability to organize the technological process of manufacturing apparatus for chemical industries.

##### 1.2. The main tasks of the credit module

After mastering the credit module, students must demonstrate the following learning outcomes:

KNOWLEDGE:

- ensuring the manufacturability of manufacturing apparatus for chemical industries;
- organization of technology for the production of equipment for chemical industries.

SKILLS:

- using the reference data, perform a comparison of various types of structural materials regarding suitability for the manufacture of products with a given functional purpose;
- using the reference materials, perform actions to change the shape in accordance with the properties of the selected materials and the functional purpose of products made from them;
- using reference data, develop processes of thermal and thermochemical processing of parts;

- using the reference and design data to carry out static and dynamic balancing of shafts and cylinders;
- using design documentation, develop technological processes for the production of tubular, suction, press, and granite shafts;
- using the design documentation, develop technological processes for the manufacture of drying and refrigerating cylinders;
- using design documentation, develop technological processes of manufacturing metal and thrust shafts of calenders.

The knowledge, skills and experience gained while studying this discipline will be useful for further professional activities.

**requisites and post- requisites of the discipline (place in the structural and logical scheme of training according to the relevant educational program)**

This academic discipline is optional. To successfully master this discipline, a student must meet all of the following criteria:

- have the skills and abilities to work with a personal computer at the level of a confident user;
- know and understand the basic principles of organizing and searching for information in computer systems;
- learn the "Engineering graphics" course.

## **2. Content of the academic discipline**

Educational discipline " Technology production devices " consists of the following topics:

1. General information about the material and its processing for the manufacture of apparatus for chemical industries.
2. Production of shafts and cylinders of chemical production equipment.

## **3. Educational materials and resources**

### ***Basic literature***

1. Horbatiuk, Yeremiy Oleksandrovych, author . Mechanical engineering technology: a study guide / E.O. Horbatiuk, M.P. Mazur, A.S. Zenkin , V.D. Karazey . - Lviv: Novy svit-2000, 2019. - 358 pages: drawings.
2. Mikulonok , Ihor Olegovich. Production of equipment for chemical industries : a study guide for students studying for special "Equipment of chemical production and construction materials enterprises" / I. O. Mikulonok ; NTUU "KPI". - Kyiv: KPI, 1999. - 199 [1] p. : ill ., table.
3. Malitskyi , Ihor Fedorovych. Mechanical engineering technology: education . help \_ for studies \_ engineering specialists / I.F. Malitskyi ; MES of Ukraine, Ukrainian Engineering and Pedagogical Academy. - Kharkiv, 2011. - 152 p. : fig .
4. Bozhidarnik , Viktor Volodymyrovych Production technology of product details: Education . help \_ / V. Bozhidarnik , N. Grigorieva, V. Shabaykovich ; Lutsk State . technical \_ Univ. - Lutsk: " Nadstryya ", 2006. - 592 p.
5. Mechanical engineering technology: a textbook for students . university for example "Computer systems, automation and control, "Automation and computer-integrated technologies", "Engineering mechanics" / P.P. Melnychuk, A.I. Borovyk, P.A. Linchevskyi , Yu.V. Petrakov ; Zhytomyr State Technological University - Zhytomyr: ZHTU, 2005. - 882 p.

### ***Additional literature***

6. Calculation of shafts and selection of dynamic rolling bearings cargo lifters . Methodical instructions for the course "Machine parts and construction basics": For students . mechanical engineering special all forms of education . / On \_ O. P. Poleshko . - K.: KPI, 1997. - 56 p.

7. Ivanchenko, Fedir Kindratovych, 1918-2005. Calculation of machines and mechanisms of rolling shops : training . study guide . \_ universities that study disc . "Mechanical equipment of metallurgical plants" and "Calculation and design of metallurgical machines and units". F. K. Ivanchenko, V. M. Grebenyk , V. I. Shiryayev . - Kyiv: Higher School, 1995 - 453, [1] p. : ill ., table.
8. Drachev , Oleg Ivanovich . Security operational properties products with automated проектировании / O.I. Drachev , A.N. Kravtsov, N.V. Kravtsov; science ed. V.G. Mitrofanov; Society \_ ed. sir Yu.M. Solomentsev ; closed joint stock " ONYS " society. - Irbit : ONYS, 2011. - 257 p.
9. Markhel , Ivan Ivanovich. Machine details: training . help \_ for universities / I.I. Marchel . - K.: Alerta , 2005. - 368 p.
10. Pavlyshche , Volodymyr Teodorovych. Fundamentals of design and calculation of machine parts: a textbook for students . Eng . - Tech . special universities ( diss . "Machine parts and design basics") / V.T. Pavlyshche . - K.: Higher school, 1993. - 556 p.
11. Fomichev, Serhiy Kostiantynovych, 1954- , author. Quality management in welding production: a textbook for students and postgraduates in the specialty 131 "Applied mechanics": in 11 volumes / S.K. Fomichev, I.O. Skachkov , E.P. Chvertko, S.M. Minakov , A.V. Banin ; edited by Boris Paton; Ministry of Education and Science of Ukraine, National Technical University of Ukraine "Kyiv Polytechnic Institute named after Ihor Sikorskyi", Personnel Training Center of the International Institute of Welding, Institute of Electric Welding named after E. O. Paton. - Kyiv: KPI named after Igor Sikorskyi, 2022. - 11 volumes: drawings, tables.
12. Vlasov, Anatoly Fedorovych, author . New and effective technologies in welding and related processes: a study guide for graduate students of specialties 132 "Materials science, 131 "Applied mechanics" / A.V. Vlasov; Ministry of Education and Science of Ukraine, Donbas State Mechanical Engineering Academy. - Kramatorsk: DDMA, 2018. - 1 CD-ROM (144 pages).
13. Chubenko, Victoria Anatoliivna, author . The technology of metal processing processes by pressure: a study guide for students of higher educational institutions who study in the specialty "Metallurgy" / V.A. Chubenko, A.A. Khinotska . - Kryvyi Rih: Publisher Chernyavskiy D.O., 2020. - 206 pages: drawings, tables.
14. Non-ferrous metals and alloys: study guide / L. Bohun [and others]; edited by Z. Duryagina ; Ministry of Education and Science of Ukraine, Lviv Polytechnic National University. - Lviv: Publishing House of Lviv Polytechnic, 2017- - part.: ill ., table.

## Educational content

### 4. Methods of mastering an educational discipline (educational component)

#### *The structure of the credit module*

Names of sections, topics	Number of hours				
	In total	including			
		Lecture s	Practical training	Laborat ory	SRS
Section 1. General information about the material and its processing for the manufacture of apparatus for chemical industries.					
Topic 1.1. Regulatory and technical guidelines materials . Nomenclature of rolled metallurgical steel. Technical conditions for metal products . Welded structures	8	2	2		4
Topic 1.2. Thermal and thermochemical treatment of elements of chemical production apparatus. Application polymers for the creation of apparatus for chemical production	8	2	2		4
Section 2. Production of shafts and cylinders of chemical production devices .					
Topic 2. 1 . Technology production tubular shafts	10	2	4		4
Topic 2. 2 . Technology production suction shafts	10	2	4		4

Topic 2. 3 . Technology production press shafts	10	2	4		4
Topic 2.4. Technology of manufacturing granite shafts	10	2	4		4
Topic 2. 5 . Technology production drying and refrigerating cylinders	12	2	6		5
Topic 2. 6 . Technology production calender shafts	10	2	4		4
Topic 2. 7 . Balancing rotors Technology facing shafts and their finish line processing and _	12	2	6		4
Calculation work	16				16
<i>MKR</i>	4				4
<i>Test</i>	6				6
<b>Hours in general</b>	<b>120</b>	<b>18</b>	<b>36</b>		<b>66</b>

### **Lecture classes**

No. z/p	The name of the topic of the lecture and a list of the main questions (a list of didactic tools, references to the literature and tasks on the SRS)
<b>Section 1. General information about the material and its processing for the manufacture of apparatus for chemical industries.</b>	
	Lecture 1. Regulatory and technical guidelines materials . Nomenclature of rolled metallurgical steel. Technical conditions for metal products . Welded structures Literature [1-5, 11, 12, 14]. Tasks on SRS. Assortment and technological features of the use of rolled steel.
	Lecture 2. Thermal and thermochemical treatment of elements of chemical production apparatus. Application polymers for the creation of apparatus for chemical production. Literature [1, 2, 3, 13, 14]. Tasks on SRS. Methods definition hardness became _
<b>Section 2. Production of shafts and cylinders of chemical production equipment.</b>	
	Lecture 3 . Technology production tubular shafts _ Literature [ 1-5 ]. Tasks on SRS. Mechanical processing tubular shafts _
	Lecture 4 . Technology production suction shafts Literature [ 1-5 ]. Tasks on SRS. Production blanks shafts _
	Lecture 5 . Technology production press shafts Literature [ 1-5 ]. Tasks on SRS. final mechanical processing in folded condition _
	Lecture 6 . Technology of manufacturing granite shafts Literature [ 1-5 ]. Tasks on SRS. Substitutes granite during production shafts _
	Lecture 7 . Technology production drying and refrigerating cylinders Literature [ 1-5 ]. Tasks on SRS. Technology assembly of the drying cylinder . final treatment of the drying cylinder in the folded condition _
	Lecture 8 . Technology production calender shafts Literature [ 1-5 ]. Tasks on SRS. final mechanical processing calender shafts _
	Lecture 9. Balancing of rotors Technology of facing shafts and their finishing. Literature [1-5]. Tasks on SRS. Elimination imbalances third and higher orders of magnitude

### **Practical training**

No. z/p	The name of the topic of the lecture and a list of the main questions (a list of didactic tools, references to the literature and tasks on the SRS)
------------	--

<b>Section 1. General information about the material and its processing for the manufacture of apparatus for chemical industries.</b>	
Practical 1, 2 . Regulatory and technical guidelines materials . Nomenclature of rolled metallurgical steel. Technical conditions for metal products . Welded structures Literature [1-5].	
Practical 3, 4. Thermal and thermochemical treatment of elements of chemical production apparatus. Application polymers for the creation of apparatus for chemical production. Literature [1, 2, 3, 13, 14].	
<b>Section 2. Production of shafts and cylinders of chemical production equipment.</b>	
Practical 5, 6 . Technology production tubular shafts _ Literature [ 1-5 ].	
Practical 7, 8 . Technology production suction shafts Literature [ 1-5 ].	
Practical 9, 10 . Technology production press shafts Literature [ 1-5 ].	
Practical 11, 12 . Technology of manufacturing granite shafts Literature [ 1-5 ].	
Practical 13, 14 . Technology production drying and refrigerating cylinders Literature [ 1-5 ].	
Practical 15, 16 . Technology production calender shafts Literature [ 1-5 ].	
Practical 17, 18. Balancing of rotors. Technology of facing shafts and their finishing. Literature [1-5].	

### **Laboratory classes**

According to the curriculum, laboratory classes are not provided.

### **Graphic work**

It involves conditionally disassembling the device into its constituent elements and drawing up a step-by-step plan for its manufacture.

## **5. Independent work of student**

Independent work of students within this course involves:

- preparation for the lecture, which includes familiarization with the provided text of the lecture, identification of poorly understood fragments and theses, identification of issues that, in the student's opinion, require more extensive coverage, preparation of questions to the teacher that are planned to be asked during the lecture (up to 1-2 hours for each lecture) ;
- preparation for practical classes, which includes familiarization with the topic and purpose of the class, task, familiarization with control questions and formation of answers to them (up to 30-60 minutes for each practical work);
- preparation of reports based on the results of work carried out in practical classes (up to 30-60 minutes for each practical class);
- development of the device according to the task as the performance of calculation work (16 hours).
- preparation for the modular control work (2 hours);
- preparation for the test (6 hours).

## **Policy and control**

## **6. Policy of educational discipline**

The system of requirements that the teacher sets before the student:

### **6.1. Attendance and behavior in classes.**

- the student must come to class prepared;
- turning off mobile phones or switching them to silent mode in all classes and during consultations is mandatory;
- attendance at lectures on the discipline is welcome and will contribute to better learning of the discipline;
- the student's activity in lectures and the ability to ask questions about the topic of the lecture to the teacher are welcome;
- attending laboratory classes and completing tasks during practical classes is mandatory;
- the use of information search tools is allowed (except for control classes);
- free movement of the audience is allowed during practical (but not lecture) classes.

### ***6.2. Issuance of penalty and incentive points.***

- incentive points are awarded to students who completed additional work tasks or tasks of increased complexity during the class;
- incentive points are awarded to students who proposed a different way of completing the task, not provided for in the work plan;
- skipping practical classes without a good reason leads to the issuance of zero points according to its results, but it is absolutely necessary to complete the work tasks;
- skipping the modular test without a good reason leads to the issuance of zero points based on its results.

### ***6.3. Policy of deadlines and rescheduling.***

- at the beginning of the next practical session, the student must submit a completed report based on the results of the previous session;
- repeated execution of modular control work is not allowed;
- writing a modular test by students who did not write it on time without a good reason is not allowed;
- retaking the test is allowed only in the manner prescribed by the normative documents on the organization of the educational process of KPI named after Igor Sikorsky.

### ***6.4. Academic Integrity Policy.***

- students studying the discipline must adhere to the rules and norms of academic integrity when performing all types of work;
- calculation and graphic work performed in gross violation of the rules and norms of academic integrity is evaluated with a score of 0 points, in addition, the student is awarded 4 penalty points when issuing a repeated assignment.

## **7. Types of control and rating system for evaluating learning outcomes (RSO)**

The student's credit module rating consists of points obtained for:

- 1) performance of 18 practical works in classroom classes;
- 2) execution of modular control work;
- 3) execution of graphic work.

### ***8.1. Performance of practical works.***

A total of 18 practical works are provided during the semester. The weighted point is 3. The maximum number of points for all works is equal to  $2 \times 18 = 36$  points. Points are awarded as follows:

- work tasks were completed correctly and on time, within the set time of the lesson, correct answers were received - 2 points;
- the task of the work was completed partially correctly during the set time of the lesson, and it was not completed completely, in a time exceeding the time of the practical lesson, a part of the correct answers was received - 1 point;
- the work task was not completed or was completed completely incorrectly - 0 points.

*Note:* if the student was absent from the class for a valid reason, which is documented and presented at the next class the completed task of the missed work, the work is considered completed on time.

### 8.2. Modular control work.

The weighted score is 14. The assessment of the work task is carried out according to the following scale:

- data analysis is correct, the answer is correct - 14 points;
- the data analysis is correct, the answer is correct, there are minor inaccuracies - 10-13 points;
- the course of data analysis is generally correct, but there are errors that do not make it possible to get a correct answer, only the analysis algorithm is given, but the analysis itself is missing or completely incorrect - 6-9 points;
- the completed task has a range of critical errors - 1-5 points
- incorrectly selected data analysis method, incorrectly selected analysis algorithm or missing task - 0 points.

### 8.3. Calculation work

The weighted score is 10. The calculation work consists of a complex task.

Evaluation of the work task is carried out according to the following scale:

- performing the task correctly and without errors - 10 points;
- the execution of the task is correct and without errors, there are minor inaccuracies or irrationally chosen solutions for the execution of the task, but which allowed to obtain the correct result - 8-9;
- the progress of the task is generally correct, but there are non-critical errors, the prompt correction of which will allow you to get the correct answer - 6-7 points;
- the progress of the task is generally correct, but there are rather gross errors that do not allow to get the correct answer - 4-5 points;
- only certain fragments are given correctly, but the task itself is not completed, or is completed completely incorrectly - from 1-3 points;
- the method of performing the task is incorrectly chosen, the calculation formulas are incorrectly specified or the task is missing, work performed in gross violation of the rules and norms of academic integrity is evaluated with a score of 0 points.

The maximum number of points during the semester is:  $R = 36 + 14 + 10 = 50$  points.

Calendar control : *is carried out **twice a semester** as a monitoring of the current state of meeting the requirements of the syllabus .*

According to the results of the educational work in the first 7 weeks, the "ideal achiever" should score 14 points. At the first attestation (8th week), the applicant receives "credited" if his current rating is at least 7 points.

According to the results of the educational work for 13 weeks of training, the "ideal achiever" should score 40 points. At the second attestation (14th week), the applicant receives "credited" if his current rating is at least 20 points.

The maximum number of points is 100.

Semester control : **credit**.

**The credit work** consists of 3 theoretical questions (the first two 15 points each, the third 20 points).

Table of correspondence of rating points to grades on the university scale :

<b>Scores</b>	<b>Rating</b>
100 ... 95	<i>perfectly</i>
94 ... 85	<i>very good</i>
84 ... 75	<i>fine</i>
74 ... 65	<i>satisfactorily</i>
64 ... 60	<i>enough</i>
0 ... 60	<i>unsatisfactorily</i>
20	<i>not allowed</i>

## 8. Additional information on the discipline (educational component)

### 9.1. Completion of credit work.

The weighted score of the assessment is 50 points. The work consists of three practical tasks. The weighted score of the first two tasks is 15 points, the third task is 20 points. The practical task involves the student solving typical problems from the credit module. The assessment of the practical task is carried out according to the following scale:

- the approach to the solution is correct, the answer is correct - from 14(19) to 15(20) points;
- the approach to the solution is correct, but the answer is incorrect due to the presence of minor errors - from 11(15) to 13(18) points depending on the number of indicated errors;
- the approach to the solution is generally correct, but there are sufficiently gross errors that do not make it possible to get a correct answer - from 6(10) to 10(14) points, depending on the number and severity of errors;
- only fragments of the task are correctly given, but the task itself is missing or completely incorrect - from 1 to 5(9) points depending on the number and correctness of the available elements;
- the calculation method is incorrectly chosen, the solution strategy is incorrectly chosen or the task is missing - 0 points.

### 9.2. Enrollment of distance or online course certificates.

For students who have completed distance learning or online courses on the relevant subject, this training can be counted as studying this academic discipline if all the following conditions are met:

- the student provided a certificate or other document that confirms his completion of a distance or online course and provided an opportunity to verify its authenticity;
- a distance or online course posted on the platform or conducted by an organization that is recommended or recognized by KPI named after Igor Sikorskyi;
- the volume of a distance or online course is at least 108 study hours;
- the list of topics studied in the distance or online course contains at least four topics specified in the content of the academic discipline (item 3 of the syllabus ); in the case of a difference in titles, the correspondence of the content of the topics is established on the basis of a comparative analysis with the distance or online course program;
- the student's success rate based on the results of studying a distance or online course is at least 75% of the maximum.
- 

**The working program of the academic discipline ( syllabus ):**

***was compiled by an associate professor of the MAHNV department, candidate of technical sciences **Oleg NOVOKHAT*****

***adopted by the department of machines and devices of chemical and oil refining industries***  
(protocol No. 20 dated 20.06.2022)

***approved by the Methodical Commission of the Faculty of Engineering and Chemistry***  
(protocol No. 10 dated 24.06.2022 )