Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Department of machines and devices of chemical and oil refining industries

Processes of quality control of manufacturing, repair and operation of chemical engineering equipment

Working program of the academic discipline (Syllabus)

Details of the academic discipline

Level of higher education	***First (undergraduate)***
Branch of knowledge	*13 "Mechanical engineering"*
Specialty	*133 Industrial engineering*
Educational program	*Computer-integrated technologies of chemical engineering equipment design*
Discipline status	*selective*
Form of education	*daytime*
Year of training, semester	*3rd year, autumn semester*
Scope of the discipline	*4 ECTS credits / 120 hours*
Semester control/ control measures	*, modular control work, abstract*
Lessons schedule	*3 hours per week (1 hour of lectures and 2 hours of practical classes)*
Language of teaching	*Ukrainian*
Information about the head of the course / teachers	**Lecturer:** *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* **Practical:** *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	*https://ci.kpi.ua/uk/silabus-2022-2023/*

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 :

- selection of methods and means of measurement;
- development of technology for assembling a component unit of technological equipment;
- development of technology for mounting devices on the foundation;
- operation of technological equipment of the industry;
- organization of repair and restoration of technological equipment;
- development of measures for repair and restoration of technological equipment;
- repair and restoration of technological equipment;
- make a justified choice of equipment for various chemical industries;
- perform parametric and mechanical calculations of equipment.

1.2. The main tasks of the credit module

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

KNOWLEDGE:

- correctly define the methods of measuring physical quantities. Correctly choose the means of measurement;

- using the drawing of the assembly unit of the machine, determine the sequence of assembly operations;
- using the acquired knowledge of assembly principles, develop a technological assembly scheme with the necessary technical conditions for performance of work;
- using regulatory and technical documentation, to compile a consistent technical description of assembly operations;
- using regulatory and technical documentation, choose a tool for assembly operations;
- using regulatory and technical documentation, build linear and network schedules of equipment installation with calculation of the duration of individual operations and installation as a whole;
- using regulatory and technical documentation, a passport and technical conditions for the machine, develop an operational installation map, calculating the duration of individual operations and choosing rigging devices and tools;
- using regulatory and technical documentation, linear and network schedules of installation, operational map of installation, calculate the need for the number of workers and their qualifications, determining safety measures during installation;
- to carry out experimental studies of repair and installation processes of CSP equipment;
- using regulatory and technical documentation, develop standards and labor intensive repair, perform drawings of repairable parts;
- using regulatory and technical documentation, develop a project for the organization of repair work, determining the need for lifting equipment, tools and devices;
- using the materials of the repair work organization project, develop linear and network schedules of major repairs, performing calculations of the duration of the preparation and repair operation;
- using regulatory and technical documentation, passport and technical conditions, choose the method of equipment repair;
- using regulatory and technical documentation and the company's capabilities, draw up technological regulations for cleaning machines and parts;
- using data on characteristic damage of parts and assembly units, evaluate the economic feasibility and technical possibility of recovery or repair;
- using the results of the analysis of characteristic types and sizes of damage, propose technical means of restoration or repair of parts or a component unit;
- using regulatory and technical and reference documentation, develop a complete list of documentation for the production process of restoration and repair of parts and assembly units;
- using regulatory and technical documentation, develop methods of trial start-up, load tests and break-in under load after overhaul;
- using regulatory and technical and reference documentation, develop safety measures during installation, operation and repair of equipment;
- using the technical specifications, machine passport, control and measuring devices and methods, conduct machine tests after repair and analyze the results;
- using regulatory and technical documentation, evaluate the technical condition of components and parts and their repairability;
- using regulatory and technical documentation, carry out defects of worn parts and assembly units by manual and technical diagnostic methods;
- using parts or assembly units after operation, visually or with the help of control and measuring devices and reference literature, detect characteristic damage, carry out defects and compile a defect report;
- using the standard of the planned and warning system of technical maintenance and repair of equipment, organize the accounting of accidents and injuries related to the equipment;
- using the results of the analysis of wear factors, determine a list of measures to reduce the wear of equipment parts;
- using regulatory and technical documentation and equipment passports, develop equipment lubrication maps;

- using modern measurement methods, determine the wear and tear of equipment parts;
- using modern measurement methods, determine the wear and tear of equipment parts;
- using control and measuring devices and tools, measure the thickness and strength of the reinforced material layer of machine parts . The knowledge , skills and experience gained during the study of 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

The educational discipline "Processes of quality control of manufacturing, repair and operation of chemical engineering equipment" consists of the following sections:

1. Quality control of manufacturing and installation of chemical production equipment.
2. Repair and operation of chemical production equipment.

3. Educational materials and resources

Basic literature

1. Operation and maintenance of equipment of technological facilities of chemical oil refineries and petrochemical industries / V.L. Yushko [and others]; Ministry of Education and Science of Ukraine. - Dnipropetrovsk: [DVNZ UDHTU], 2016. - 290 p. : tab.
2. Kravchenko, Vladimir Mykhailovych, author . Operation and repair of mechanical equipment industrial of enterprises : textbook / V.M. Kravchenko, A.A. Ishchenko , V.G. Artyukh , V.A. Sidorov; Pryazovsky state technical university _ - Mariupol ; - Zaporozhye : Publisher VV Mokshanov , 2021. - 315 pages: drawings, tables.
3. Gavrish, Pavlo Anatoliyovych, author . Peculiarities of methods of repairing metal structures by welding: a study guide for students of training in field 13 - "Mechanical engineering", specialties 133 - "Industrial mechanical engineering" and 131 - "Applied mechanics" / P.A. Gavrish; Ministry of Education and Science of Ukraine, Donbass State Machine-Building Academy (DSMA). - Kramatorsk: DDMA, 2020. - 119 pages: figures, tables.
4. Malt, Volodymyr Yuriyovych, 1956-, author. Operation and repair of technological equipment of mechanical shops : a study guide for students of higher educational institutions / V.Yu. Malt, O.V. Chernyshov; Ministry of Education and Science of Ukraine, Dnipro State Technical University (DDTU). - Kamianske : DDTU, 2018. - 275 pages: drawings, tables, diagrams.

Additional literature

5. Petrenko, Andrii Volodymyrovych. Technologies of maintenance and repair of electrical installations: study guide for the disciplines "Technologies of maintenance and repair of electrical installations" for the specialty "141 - Electric power, electrical engineering and electromechanics", master's program "Electrical networks and systems" / A.V. Petrenko, S.S. Makarevich _ - Kyiv: Comprint , 2017.
6. Kaptsov, Ihor Ivanovich. Repair technology of gas equipment and pipeline systems: monograph / I.I. Kaptsov, V.G. Kotukh, Yu.V. Pakhomov; Ministry of Education and Science of Ukraine, Kharkiv National University of Urban Economy named after O.M. Beketova. - Kharkiv: XNUMX named after OHM. Beketova, 2016. - 231 p. : ill., tab.

7. Lesko, Vitaly Ivanovych. Operation and repair of machines: a summary of lectures for students studying in the areas of training 6.010104 "Professional education. Mechanical engineering": in three parts / V. I. Lesko, M. P. Kuzminets , E. O. Mishchuk; Ministry of Education and Science of Ukraine, Kyiv National University of Construction and Architecture. - Kyiv: KNUBA, 2016.
8. Repair of the technological equipment of compressor stations: a study guide for students of higher educational institutions who study in the specialty "Gas turbine installations and compressor stations" / [A.P. Kudrin and others] ; Ministry of Education and Culture of Ukraine, National Aviation University. - Kyiv: NAU, 2015. - 187 p.
9. Installation, operation and repair of hydraulic machines and hydropneumatic drives : a study guide / [V.O. Panchenko [and others]; Ministry of Education and Science of Ukraine, Sumy State University. - Sumy: Sumy State University, 2015. - 150 p. : ill ., table.
10. Kovalenko, Ihor Valentinovych, 1948- Installation, operation and repair of chemical production equipment: a study guide for students of higher educational institutions who study in the fields of "Engineering Mechanics", "Chemical Technology and Engineering" / I. V. Kovalenko. - Kyiv, 2011. - 559 p.
11. Konovalov, Stanislav Vasyliovych. Technology of operation and routine work of gas equipment. The profession of locksmith for maintenance and repair of gas equipment / S.V. Konovalov. - Vinnytsia: PP Balyuk , 2007. - 564 p.

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			
		Lectures	Practical training	Laboratory	SRS
Chapter 1. Manufacturing quality control and installation of chemical production equipment					
Basic terminology. Methods of assessing the quality of chemical processing equipment manufacturing .	12	2	4		6
Installation of chemical production equipment.	38	8	16		14
Chapter 2. Repair and operation of chemical production equipment					
Types of repairs.	12	2	4		6
Types of repair work.	20	4	8		8
Safety equipment.	12	2	4		6
Abstract	16				16
MKR	4				4
Test	6				6
Hours in general	**120**	**18**	**36**		**66**

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)
Chapter 1. Manufacturing quality control and installation of chemical production equipment	
1	Introduction. The purpose and objectives of the course. Life cycle of production equipment. Reliability indicators. Basic regularities. Introduction to the course. The essence and tasks of production equipment. Indicators of terrotechnology . Basic and operational reliability Factors of terrotechnology . Basic regularities.

	Literature: 1, 2, 3. Tasks on SRS. Reliability indicators. The existence cycle of reliability.
2	Specifics of installation work. The specifics of installation work, requirements for the design of the CPV equipment. Basics of organization of installation work. ***Literature: 1, 2, 3, 5.*** Tasks on SRS. Measuring instruments and testing equipment.
3	Installation of equipment on the foundation. Installation of equipment on the foundation. Basic requirements for calibration and installation. Technical requirements for the foundation. Fastening and installation of equipment on the foundation. Slinging, calculation dependencies. Axes, slats, benchmarks. ***Literature: 1, 2, 3, 5, 7, 8.*** Tasks on SRS. Calculated dependences on foundations.
4	Features of installation of technological lines. Features of the technological chain. Design features of tires. Checking the installation of the foundation. ***Literature: 1, 3, 5, 7, 10, 11.*** Tasks on SRS. Requirements for securing tires to the foundation.
5	Installation of calender, drives. Basic tolerances for installation. Installation of the calender. Basic tolerances and controlled dimensions. Installation of drives. ***Literature: 1, 2, 3, 7, 9, 10, 11.*** Tasks on SRS. Installation of super calender.
Section 2. Section 2. Repair and operation of chemical production equipment	
6, 7	Types of repairs. System of planned and preventive repairs (PZR). Equipment supervision and care. PZR graphs. Equipment repair. Basics of repair organization and its types. Repairs. A system of planned and preventive repairs. PZR graphs. Categories of repair complexity, normalization of repair works by units of repair complexity ***Literature: 1, 3, 7, 8, 10, 11.*** Tasks on SRS. Supervision and maintenance of electrical equipment.
8	Damage to parts during operation. Means of their recovery. Damage to parts during operation and means of their restoration. Determining the service life of parts. Basics of equipment repair technology. Disassembly and assembly. Map of equipment assembly. Inspection during assembly. Checks for concentricity, parallelism, and perpendicularity. Balancing. Control of the assembly process. ***Literature: 1, 2, 3, 5, 7.*** Tasks on SRS. Combating wear and tear of parts. Processing and fitting of parts.
9	Safety equipment and fire-fighting equipment during work. Safety and fire safety techniques during installation and commissioning works. Safety techniques during repair work. ***Literature: 1, 10.*** Tasks on SRS. Responsibility of work managers for the implementation of safety and fire safety rules.

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)
Chapter 1. Manufacturing quality control and installation of chemical production equipment	
1, 2	Establishing reliability indicators for parts on the example of creating a shell under internal pressure. ***Literature: 1, 2, 3.***
3, 4	Development of an algorithm for assembly works ***Literature: 1, 2, 3, 5.***
5, 6	Fastening and installation of equipment on the foundation. Slinging, calculation dependencies. Axes, slats, benchmarks. ***Literature: 1, 2, 3, 5, 7, 8.***
7, 8	Calculation of assembly works of the technological line.

	Literature: 1, 3, 5, 7, 10, 11. Tasks on SRS. Requirements for securing tires to the foundation.
9	Installation of the calender. ***Literature: 1, 2, 3, 7, 9, 10, 11.*** Tasks on SRS. Installation of super calender.
10	Assembly of the drive. ***Literature: 1, 2, 3, 7, 9, 10, 11.***
Section 2. Section 2. Repair and operation of chemical production equipment	
11-14	Calculation of organizational work on equipment repair. ***Literature: 1, 3, 7, 8, 10, 11.***
15	Determining the service life of parts. ***Literature: 1, 2, 3, 5, 7.***
16	Shaft balancing. ***Literature: 1, 2, 3, 5, 7.***
17	Establishing concentricity, parallelism and perpendicularity . ***Literature: 1, 2, 3, 5, 7.***
18	Establishment of danger factors during the operation of chemical production equipment ***Literature: 1, 10.***

Laboratory classes

According to the curriculum, laboratory classes are not provided.

Abstract

It involves writing an essay according to the issued topic (description of installation and repair work on a specific chemical equipment device).

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, need more extensive coverage, preparation of questions to the teacher that are planned to be asked during the lecture;
- preparation for practical classes, which includes familiarization with the topic and purpose of the class, tasks, familiarization with control questions and formation of answers to them;
- preparation of reports based on the results of work carried out in practical classes;
- development of an abstract;
- preparation for modular control work;
- 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 practical classes and completing tasks during the practical class 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) writing an essay.

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 $3 \times 18 = 54$ 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 - 3 points;
- the work task 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 obtained - 1-2 points;
- 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 16. The evaluation of the work task is carried out according to the following scale:

- data analysis is correct, the answer is correct - 16 points;
- the data analysis is correct, the answer is correct, there are minor inaccuracies - 12-15 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 - 7-11 points;
- the completed task has a range of critical errors - 1-6 points
- incorrectly selected data analysis method, incorrectly selected analysis algorithm or missing task - 0 points.

8.3. Abstract

The weighted score is 30. 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 - 30 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 - 22-29;
- the progress of the task is generally correct, but there are non-critical errors, the prompt correction of which will make it possible to get the correct answer - 14-21 points;
- the progress of the task is generally correct, but there are sufficiently gross errors that prevent a correct answer - 6-13 points;
- only certain fragments are given correctly, but the task itself is not completed, or is completed completely incorrectly - from 1-5 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 amount of points during the semester is: ***R = 54 + 16 + 30 = 100 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 21 points. At the first attestation (8th week), the applicant receives "credited" if his current rating is at least 10 points.

According to the results of the educational work for 13 weeks of training, the "ideal achiever" should score 55 points. At the second attestation (14th week), the applicant receives "credited" if his current rating is at least 27 points.

The maximum number of points is 100.

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

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

Semester control *:* ***credit.***

If the student receives less than 60 points or if he wishes to increase the total score, all points received for practical tasks and modular control work are canceled (with no possibility of cancellation if the student receives a lower score for the credit work). Points for the abstract work are saved. The student is given a credit assignment for 70 points.

The credit work *consists of 3 theoretical questions (the first two 20 points each, the third 30 points).*

8. Additional information on the discipline (educational component)

9.1. Completion of credit work.

The weighted score of the assessment is 70 points. The work consists of three practical tasks. The weighted score of the first two tasks is 20 points, the third task is 30 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 19(29) to 20(30) points;
- the approach to the solution is correct, but the answer is incorrect due to the presence of minor errors - from 11(15) to 18(28) 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.
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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)