



EQUIPMENT DESIGN

Educational component work program (Syllabus)

Educational component details

Level of higher education	<i>Second (Master's)</i>
Discipline	<i>G - Engineering, Manufacturing and Construction</i>
Specialty	<i>G11 "Mechanical Engineering"</i>
Educational program	<i>OPP Engineering of innovative industry equipment</i>
Status of the educational component	<i>Required</i>
Form of study	<i>full-time (day)</i>
Year of training, semester	<i>1st year, fall semester</i>
The scope of the educational component	<i>6.0 (180)</i>
Semester control/control measures	<i>Exam</i>
Class schedule	<i>4 hours per week (2 hours of lectures and 2 hours of practical classes)</i>
Language of instruction	<i>Ukrainian</i>
Information about the course leader /teachers	Lecturer: Prof., Doctor of Technical Sciences, Valeriy Yuriyovych Shcherbina, https://cpsm.kpi.ua/shcherbina-valerij-yurijovich.html?tmpl=component ; Practical / Seminar: Prof., Doctor of Engineering, Valeriy Yuriyovych Shcherbina, https://cpsm.kpi.ua/shcherbina-valerij-yurijovich.html?tmpl=component ;
Course placement	<i>Sikorsky Platform</i>

Educational component program

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

The main task of design engineering is to implement the schematic diagrams obtained at the functional design stage. This involves designing individual parts, assembling assemblies from parts and structural elements, and assembling assemblies from assemblies, after which technical documentation for the design object is drawn up.

One of the most urgent problems of modern mechanical engineering is to reduce the design time of technological equipment and improve its technical and economic characteristics. This is possible with the systematic use of computer technology, which allows not only to improve but also significantly increase the productivity of the designer-designer. Thanks to the thorough study of graphic computer

systems, the designer can automate the execution of design work, as well as refine and adapt typical graphic systems for specific applied design tasks in order to effectively use equipment design systems.

Subject of the educational component "Equipment Design" – implementation of approaches that provide the study of the latest design systems and special methods for improving, increasing efficiency, ensuring high quality of design and development and implementing the most effective design solutions, which orients students to the modern world level of scientific and technical developments.

The purpose of the educational component " Equipment Design "

The purpose of studying the educational component is to form in masters a complex of knowledge about special design methods to improve, increase efficiency, ensure high quality of design and development and implement the most effective design solutions, which orients students to the modern world level of scientific and technical developments.

In accordance with the goal, the training of masters in this specialty requires the formation of the following competencies in students:

Integral competence:

The ability to solve complex tasks and problems in industrial mechanical engineering, which involves conducting research on processes, equipment and/or implementing innovations in a given industry and is characterized by uncertainty of conditions and requirements

Ability to use information and communication technologies ZK01.

Ability to learn and master modern knowledge ZK02.

Ability to search, process and analyze information from various sources ZK03.

The ability to be critical and self-critical ZK04.

Ability to adapt and act in a new situation ZK05.

Ability to generate new ideas (creativity) ZK0 6.

Ability to identify, pose, and solve problems ZK07.

Ability to make informed decisions ZK08.

Ability to work in a team ZK09.

Critical understanding of advanced scientific facts, concepts, theories, principles for the field of mechanical engineering and the ability to apply them to solve complex problems of industrial mechanical engineering and sustainable development SK02

The ability to create new techniques and technologies in the field of mechanical engineering, to protect intellectual property. SK03

Awareness of the promising tasks of modern production aimed at meeting consumer needs, mastery of trends in innovative development of technologies in the SK04 industry

Ability to develop and implement plans and projects in the field of industrial mechanical engineering and related activities, to carry out relevant entrepreneurial activities SK05.

According to the requirements of the educational and professional program, after mastering the educational component, students must demonstrate the following learning outcomes:

knowledge:

Knowledge and understanding of the principles of technological, fundamental and engineering sciences that underlie the branch of mechanical engineering of the relevant industry PRN01

skills :

Know and understand the processes of industrial mechanical engineering, have the skills to use them practically PRN03

Perform engineering calculations to solve complex tasks and practical problems in industrial mechanical engineering PRN04

2. Prerequisites and postrequisites of the educational component (place in the structural and logical scheme of training according to the relevant educational program)

*The study of the educational component " **Equipment Design** " is based on the principles of integrating various knowledge obtained by students during the bachelor's degree when studying educational components of the natural and engineering directions, in particular: "Mathematics", "Engineering and Computer Graphics", "Informatics", "Resistance of Materials", "Machine Parts", "Hydraulics and Drives of Mechatronic Systems", "Theoretical Fundamentals of Heat Engineering", "Mechanics of a Deformed Solid", "Technological Fundamentals of Mechanical Engineering", "Modern Methods of Calculation of Processes and Apparatuses", "Processes, Apparatuses and Machines of the Industry".*

3. Content of the educational component

Topic 1 Overview of systems used for structural engineering

Topic 2 Composition and structure of systems for equipment design

Topic 3 ASAD design system. Commands for executing and viewing drawings

Topic 4 Features and tools of 3D modeling

Topic 5 Functional Language "AutoCAD-AutoLISP"

Topic 6 Dialogue Control Language – DCL

4. Educational materials and resources

Basic literature

- 1Shcherbyna V.Yu. Design design of equipment. Lecture notes [Electronic resource] / Igor Sikorsky Kyiv Polytechnic Institute. Kyiv, 2018. – 83 p. URL: <http://ela.kpi.ua/handle/123456789/25669>
- 2A.O. , Shvachko D.G. AutoLISP in the design of technological equipment [Electronic resource] / Igor Sikorsky Kyiv Polytechnic Institute. Kyiv, 2024. 175 p. URL: <https://ela.kpi.ua/handle/123456789/45732>
- 3A.R. Shell-and-tube heat exchangers. Design design of equipment [Electronic resource] / Igor Sikorsky Kyiv Polytechnic Institute. Kyiv, 2024. 117 p. URL: <https://ela.kpi.ua/handle/123456789/67996> .
4. Shcherbyna V.Yu., Chemerys A.O., Design design of equipment. Laboratory practical course on the academic discipline [Electronic resource] / Igor Sikorsky Kyiv Polytechnic Institute. Kyiv, 2018. – 38 p. URL: <http://ela.kpi.ua/handle/123456789/25666>
- 5Automation of graphic design work in the process of designing chemical equipment in the AutoCAD system: Manual. / V.Yu. Shcherbyna, O.S. Sakharov, O.V. Gondlyakh, V.I. Sivetsky. – K.: IVC "Publishing house "Polytechnika", 2013. – 152p.: ill.
- 6Sivetsky V.I., Shcherbyna V.Yu., Gondlyakh O.V. Engineering of innovative technologies and equipment. Lines for the production of sheet and profile polymer products [Electronic resource] / Igor Sikorsky Kyiv Polytechnic Institute. Kyiv, 2022. – 113 p. URL: <https://ela.kpi.ua/handle/123456789/45732>
7. CAD. Automated design and technological design using AutoLISP: Textbook / V.Yu. Shcherbyna, O.S. Sakharov, V.I. Sivetsky, O.V. Gondlyakh – K.: Publishing house "EKMO", 2008. – 208p.: ill.

Additional literature

8. Shcherbyna V.Yu., Gondlyakh O.V., Sivetsky V.I. Engineering of innovative technologies and equipment. Mechanical equipment for the production of binding building materials [Electronic resource] / Igor Sikorsky Kyiv Polytechnic Institute. Kyiv, 2022. – 147 p. URL: <https://ela.kpi.ua/handle/123456789/45720>
- 9Shcherbyna V.Yu., Chemerys A.O., Design design of equipment. Course project [Electronic resource] / Igor Sikorsky Kyiv Polytechnic Institute. Kyiv, 2018. – 38 p. URL: <http://ela.kpi.ua/handle/123456789/25664>

- 10 Automated design of worm equipment: Textbook / V.I. Sivetsky, V.Yu. Shcherbyna – K.: IVC “Publishing house “Polytechnics””, 2005. – 184p.: ill.
11. Hamad Munir. AutoCAD 2022 3D Modeling. Mercury Learning and Information, 2021. - 401 p. — ISBN 978-1-68392-727-3.
12. CAD. Integrated system for modeling technological processes and calculating equipment for the chemical industry: Textbook. / O.S.Sakharov, V.Yu.Shcherbina, O.V. Gondlyakh, V.I. Sivetsky. – K.: OOO “Polygraph Consulting”, 2006. – 156p.

Information resources on the Internet

13. Site <http://tomskcad.city.tomsk.net/CAD/CAD.htm>.
14. List of Visual Lisp functions <http://www.cad.dp.ua/stats/vlisp.php>
- 15 Developer Center
<https://web.archive.org/web/20081220183125/http://usa.autodesk.com/adsk/servlet/index?siteID=123112&id=770237>
16. AutoLISP Developer's Guide http://docs.autodesk.com/ACDMAC/2013/ENU/PDFs/acdmac_2013_autolisp_developers_guide.pdf
- 17 Association of Machine Builders "Ukrainian Association of Machine Building and Engineering Enterprises" (Ukragroinzhiniring) - <https://uprom.info/news/agro/ukrayinski-mashinobudivniki-ob-yednalisya-v-asotsiatsiyu-ukragroinzhiniring/>

Educational content

5. Methodology for mastering the educational component (educational component)

Lectures are aimed at:

- providing modern, holistic, interdependent knowledge with educational components, the level of which is determined by the target setting for each specific topic;
- ensuring creative work of students together with the teacher during the lecture;
- fostering professional and business qualities in students and developing their independent creative thinking;
- developing the necessary interest in students and providing direction for independent work;
- determination of the current level of development of science and technology in the field of numerical calculation methods;
- reflection of the methodological processing of the material (highlighting the main ideas and provisions, underlining conclusions, repeating them in different formulations);
- acquisition of visual, combining if possible with the demonstration of audiovisual materials, models, models and samples;
- teaching in clear and concise language, explaining all newly introduced terms and concepts;
- accessibility for audience perception.

No. of the com pan y	Title of the lecture topic and list of main questions (list of didactic aids, references to literature and tasks for the SRS)	Number of listening hours
1.	Topic 1 Overview of systems used for structural engineering Introduction. Purpose and content of the educational component. Brief information about the main stages of formation and trends in the development of automated design in the development of technological systems and mechanical equipment in chemical technology. References [1] pp. 3-24; [5] pp. 4-12 Tasks for the VTS. Stages of the product life cycle. Conceptualization, functional, design and technological design. Product utilization. Properties and	2

	characteristics of the product are functional; constructive; technological; economic; operational; ergonomic; aesthetic.	
2.	Topic 2. Composition and structure of systems for equipment design Basic information about design systems. Software complexes. Stages of work in automated design. Requirements for design systems. Specifics of designing standard equipment in chemical engineering. System structure. Structure synthesis. Provision. Features of organizing program packages. Basic principles of creating automated design systems References [1] pp. 11-15; [5] pp. 37-42; [10] pp. 41-43 Tasks for VTS. Specificity of information flows. Creation of information support. Basic requirements for information bases, information systems, interface, project modules (programs), users (designers). Information space , conceptual model, internal model. Subsystems for users to master technologies implemented in CAD. Technical (TO), mathematical (MO), software (PO), information (IS), linguistic (LO), methodological, organizational (GO) support.	2
3.	Topic 3. ASAD design system. Commands for executing and viewing drawings Automated design system AutoCAD for performing drawing work. Main menu. Command entry options. Basic system commands. Creating a work area for performing a drawing. Exiting ACAD. References [5] pp. 9-14, [7] pp. 6-12 Tasks on the CTC. Program launch window. Starting the program using an existing drawing. AutoCAD program screen. Graphics window. External links management module. CAD Standards. Toolbar positions. Closing/Opening the toolbar. Command prompt window. Menu bar. AutoCAD input methods commands. Getting help. Size , shape and directions units of measurement	2
4.	Commands for constructing graphic primitives in a drawing; constructing lines, arcs, circles. Commands: LINE, PLINE, CIRCLE, ARC. Image management. Editing constructed primitives. Commands for destroying segments: ERASE, BREAC. References [5] pp. 15-28, [10] pp. 56-60, [7] pp. 19-32 Tasks on the CTC. Data entry field. Installation bindings , nets and parallelism. Rectilinear objects, polygons, point objects, Curvilinear objects, circles, ellipses.	1
5.	Entering texts into the drawing workspace. Requirements for text drawing commands. Control codes and special characters. Selecting a text style. Texts from several lines. Dynamic text. Text templates and fonts. Drawing texts in three-dimensional structures. Complex block objects. General information about blocks. Block definition. List of blocks in the current drawing. Enabling a block in a drawing. Writing a block to disk. References [5] pp. 45-56, [7] pp. 54-63 Tasks on the CTC. Working with text. Entering text. Single-line text. Compound line (creating text in paragraphs). Editing text. Finding and replacing text. Scaling text. Aligning text. Text style. Spell checking . Controlling text display. Inserting tables. Editing text. Modifying tables.	1
6.	Topic 4. Features and tools of 3D modeling Construction of three-dimensional structures. Three-dimensional structures using ACAD. Three-dimensional polygonal meshes. General polygonal meshes (3DMESH). Connection surfaces (RULESURF). Shift commands for three-dimensional surfaces (TABSURF). Modeling surfaces of revolution (REUSURF). Creation of a three-dimensional surface given by boundary lines (EDGESURF). References [3] pp. 63-71 , [7] pp. 52-64 Tasks on the CTC. Construction planes and coordinate systems. Coordinates in three-dimensional space. Level and height. Coordinate systems. Tools for creating three-dimensional objects. Spirals and polylines. Construction of standard 3D bodies . Construction of a mesh. Dynamic creation of 3D bodies. Conversion of a planar	2

	<i>object into a 3D body. Combination of 3D bodies. Editing 3D bodies. Sections, design. Three-dimensional editing.</i>	
7.	Topic 5. AutoLISP functional language <i>Purpose and capabilities of AutoLISP, specifics and basic rules. Data types used in programming. Definition of variables, internal and external functions and lists. Example of use.</i> <i>References [2] pp. 7-9 ; [3] pp. 89-95</i> <i>Tasks on the VTS. Studying the VL text editor . Graphic editor commands. The editor's main menu. Toolbars. Entering variables, creating external functions and lists. Compiling programs. Translating programs into the AutoCAD environment.</i>	2
8.	<i>Calculation of arithmetic expressions, string functions, conditional expressions, data input-output functions. Using mathematical functions and working with data lists. Example of use.</i> <i>References [10] pp. 14-18; [7] pp. 9-11; [2] pp. 36-40</i> <i>Tasks on the CTC. Editing programs and fixing errors. Built-in and external functions. Converting numbers to strings and checking data types. Primitive access functions. Additional functions. Creating programs in the VL environment .</i>	1
9.	<i>Logical functions. Functions for branching programs, organizing loops. Functions for working with geometric descriptions of objects. Working with data lists. Calling AutoCAD commands. Special functions. System variables.</i> <i>References [5] pp.31-33 , [2] pp. 14-21 , [3] pp. 87-92</i> <i>Tasks on the CTC. Special functions. System variables. Accessing primitives and devices. Special data types. Primitive name functions. Primitive attribute processing functions. Using primitive names and selection sets.</i>	1
10.	<i>Special data types for organizing set and selection. Using the function (ssget ...). Possible modes of selecting primitives. Analysis of created sets and calling individual primitives. Examples of use in software.</i> <i>References [2] pp. 26-28, [3] pp. 122-129</i> <i>Tasks on the CTC. Special data types . Selection mode by frame, Polygon by secant line, secant polygon. Matching operators for filters. Determining the number of primitives in a set. Determining a specified primitive from a set. Removing primitives from a set and drawing.</i>	2
11.	<i>Structure of a graphical database (GBD). Data recording format for creating and editing primitives by entering data into the GBD. Attribute processing functions. Primitive names in selection sets. Access to table elements and to on-screen interactive devices .</i> <i>References [2] pp. 31-34; [3] pp. 129-131</i> <i>Tasks on the VRS. Studying the structure of a graphical database. Data recording format for creating and editing primitives by entering data into the DBD. Attribute processing functions. Primitive names in selection sets. Access to table elements and on-screen interactive devices .</i>	1
12.	<i>Functions for defining variables in AutoLISP. Functions for working with lists, strings, characters. Differences due to the use of Active advantages and the ability to create LISP programs controlled (Object Reactors). Communication functions between Visual LISP and AutoLISP. Examples of using functions in software.</i> <i>References [2] pp.39-42 , [3] pp.142-148 , [12] pp.63-71</i> <i>Tasks on VTS. Learn Visual LISP functions for defining variables in AutoLISP: vl-acad-defun, vl-acad-undefun, vl -i n i t . Study the capabilities and methods of using the function to work with lists, strings, and characters.</i>	1
13.	<i>VISUAL LISP programming system. General information about object-oriented applications Microsoft Active, ObjectARX, Microsoft Visual Basic are designed to support Activ. Functions for working with the Windows registry , directories and files on external memory devices.</i> <i>References [2] pp. 34-38 , [12] pp. 51-63</i>	2

	Tasks on the CTC. VISUAL LISP functions for working with the Windows registry : vl-registry-write , vl-registry -read , vl-registry-delete , vl-registry-descendents . Functions for working with directories and files vl-directory-files vl-file-copy vl-file-delete vl-file-rename vl-filename-directory.	
14.	Modular control work . References [5] pp. 8-39 , [2] pp. 12-27 Tasks on the CTC. Basic rules. Mathematical functions and functions for string reconstruction and data type checking. Functions for organizing loops. Functions for working with geometric descriptions of objects. System variables. Creating a parametric image of the general appearance of an object.	2
15.	Topic 6 Dialogue Control Language – DCL. Dialog control language – DCL. DCL file structure, features of functions. DCL language syntax. Managing the distribution of fields in a group. Opening and closing DCL files. Opening and closing dialog boxes. Usage examples. References [2] pp. 85-92 , [3] pp. 203-208 Tasks on the VLC. Working with the VL text editor to enter and correct DCL files. Studying the syntax of the language and the structure of the DCL file. The scheme of calling control functions. Calling from the file exsample.dcl. Opening and closing DCL files. Managing dialog boxes. Reproducing the dialog box in the editor for correction.	2
16.	Active fields in the dialog box. Predefined active fields. Predefined active field groups. Processing fields and attributes in active fields. Data linked to add-ins. References [2] pp. 92-95; [3] pp. 210-216 Tasks on the CTC. Predefined active fields. Predefined active field groups. Assigning list and drop-down list fields. Opening and closing dialog boxes. Displaying active field images on the screen : Button, EDIT_BOX, LIST_BOX, POPUP_LIST , RADIO_BUTTON , SLIDER , TOGGLE . Entering values and opening and closing active fields using LISP functions.	1
17.	Decorative and information fields. Creating images in the AutuCAD editor. Defining the color of the image and the background of the image. The ratio of the image width to height. Text string for displaying the field title and dialog box. Field separator. Using standard keyboard shortcuts. References [2] pp. 95-96 , [3] pp. 217-223 Tasks on the CTC. Decorative and information fields. Creating images. Data associated with a software application. Defined attributes. AutoLISP functions for dialog boxes. Displaying images of decorative and information fields on the screen: IMAGE_BUTTON , IMAGE , TEXT , SPACER , OK_only , OK_cancel . Defining the connection, opening and closing capabilities of decorative and information fields using LISP functions.	1
18.	AutoLISP functions for dialog boxes. Initializing action expressions and callback functions. Control function call patterns. Expressions for performing actions. Nested dialog boxes. Temporarily closing a dialog box. References [2] pp.96-98 , [3] pp.224-229 Tasks on the CTC. Initialization of action expression and call functions with return. Processing of fields and attributes. Mechanism of execution of functions load-dialog , unload-dialog , new_dialog , start_dialog , done_dialog , action_tile , mode_tile .	2
19.	Setting values for dialog box fields. Initializing modes and values. Setting list and drop-down list fields. Setting list values. Displaying an image key. Handling call groups. Setting values for a dynamic scale field. Setting values for text fields. References [2] pp.99-112 , [3] pp.230-237 Tasks on the VRS. Expressing actions. Temporarily closing dialog boxes. Initializing field modes and values. Setting list and drop-down list fields. Processing list values. Processing images. Inserting an image button. Processing sliding scales.	2
	Total	30

Practical classes

The purpose of the cycle of practical classes in the educational component is to consolidate theoretical knowledge and develop skills in working with modern systems for calculating the strength of chemical production equipment elements and mastering numerical design methods.

Practical work is carried out in a computer classroom using didactic tools and modern software from the Department of Computer Science and Engineering.

The main tasks of the practical training cycle :

- help students to systematize , to consolidate and deepen knowledge theoretical character in the field of modern methods of calculating processes and devices;
- to teach students receptions solving practical problems , contributing to mastery skills and skills performing calculations , graphics and others types of tasks ;
- to teach them to work with scientific and reference literature , documentation and diagrams ;
- to form skills to study independently , that is master methods , ways and techniques self-study , self-development and self-control.

No. of the com pan y	Title of the topic of the practical lesson and list of main questions (list of didactic material, references to literature and tasks for the CTS)	hours
1.	Topic 1 Overview of systems used for structural engineering Practical lesson 1. Introduction to the ACAD system. The purpose of the practical session is to get acquainted with the ACAD graphics system, to learn about the basic capabilities and functions of the system. References: [2] pp. 55-57; [4] pp. 7-8 Tasks on the CTC . Using image control and line drawing commands, draw the drawing frame.	2
2.	Practical lesson 2. Studying the possibilities of constructing graphic primitives using the commands: LINE, PLINE, CIRCLE, ARC. The purpose of the practical lesson is to study the possibilities of constructing graphic primitives using the commands: LINE, PLINE, CIRCLE, ARC in the ACAD graphics system. References: [2] pp. 57-59; [4] pp. 7-9 Tasks on the CTC . Draw structural elements using primitive construction commands and editing commands .	2
3.	Topic 3 ASAD design system. Commands for executing and viewing drawings Practical lesson 3. Studying the possibilities of creating special layers, applying hatching, center lines, and dimensioning. The purpose of the practical lesson is to explore the possibilities of creating special layers, applying hatching, center lines and dimensioning. References: [7] pp. 26 -31 Tasks on the CTC . Draw a part using basic AutoCAD commands.	2
4.	Practical lesson 4. Studying the possibilities of applying text information to drawings. The purpose of the practical lesson is to study the possibilities of applying text information to drawings. References: [7] pp. 31 -35 Tasks on the CTS . Draw a part using basic AutoCAD commands.	2
5.	Topic 4 Features and tools of 3D modeling	2

	Practical lesson 5. Construction of elementary 3D structures of the SOLSD type using ACAD tools. The purpose of the practical lesson is to study the possibilities of building elementary three-dimensional structures using ACAD tools. References: [7] pp. 67-81; [4] pp. 1 2-13 Tasks on the CTC . Use the AutoCAD <code>_Revolve</code> and <code>_extrude</code> commands to draw a part. Shade the part using a controlled light source. Create a characteristic section and remove the front of the part. Use the <code>_MASSPROP</code> command to find the mass and inertial properties of the structure.	
6.	Practical lesson 6. Drawing a mechanical equipment part. The purpose of the practical lesson is to explore the possibilities of drawing for detailing. References: [7] pp. 26-67; [4] pp. 13-24 Task on the CPC . Create the following layers to complete the task: "OSN" - layer for main lines, line type "CONTINUOS", color blue "7"; "OSI" - layer for axes of symmetry, line type dash-dotted "DASHDT", color blue "5"; "SHTR" - layer for hatching, color red "1"; "RAZM" - layer for dimensions and texts, color green "3". Set the working field using the <code>LIMITS</code>, <code>ZOOM ALL</code> commands. (Drawing format A3 [420 ×297]).	2
7.	Topic 5 Functional language AutoLISP. Practical lesson 7. Studying the editor for creating programs in the AutoLISP and DCL languages. The purpose of the practical lesson is to study the editor's capabilities for creating programs in the AutoLISP and DCL languages. References: [3] pp. 123-246; [2] pp. 21-54 Tasks on the CPS . Creating files of the <code><>.lsp</code>, <code><>.dcl</code> format . Entering functions and comments. Checking for errors. Translating functions into the AutoCAD environment . Implementation of the introduced functions.	2
8.	Practical lesson 8. Construction of parametric drawing elements. The purpose of the practical lesson is to study the drawing parameterization technique and use AutoLISP functions to build the structure contour. References: [2] pp. 57-59; [4] pp. 29-31 Tasks on the VTS . Develop an algorithm, a calculation scheme and a calculation program. Enter data using the program editor. Run the calculation program. Print and analyze the program text and the results obtained.	2
9.	Practical lesson 9. Creating a parameterized drawing. The purpose of the practical lesson is to master the method of synthesizing functional modules of the AutoLISP language to perform the drawing of an axisymmetric part. References: [2] p. 60; [4] p. 32 Tasks on the VTS . Enter data using the program editor. Run the calculation program. Print and analyze the program text and the results obtained.	2
10.	Practical lesson 10. Programs for modeling 3D structures such as SOLID. The purpose of the practical lesson is to master the method of synthesizing functional modules of the AutoLISP language for creating 3D models of the SOLID type part design. References: [2] pp. 61-62 ; [4] pp. 32 Tasks on the CTC . Write a program (function) for modeling a 3D SOLID-type structure. Using the capabilities of AutoCAD and Auto LISP .	2
11.	Practical lesson 11. Creating a parameterized drawing with symmetrical display of primitives. The purpose of the practical lesson is to study the method of synthesizing functional modules of the AutoLISP language to perform a drawing of a part with symmetrical display of primitives, hatching, and dimensioning . References: [2] p. 63 ; [4] p. 33	2

	Tasks on the CTC . Write a program (function) for modeling a 3D SOLID-type structure. Using the capabilities of AutoCAD and Auto LISP .	
12.	Practical lesson 12. Development of programs for building a three-dimensional model of a SOLD type structure. The goal of the practical lesson is to learn how to perform 3D designs of parts using the capabilities of AutoLISP functions and AutoCAD commands. References: [2] pp. 61-62 ; [4] pp. 33-35 Tasks on the CTC . Write a program (function) for modeling a 3D SOLID-type structure. Using the capabilities of AutoCAD and Auto LISP .	2
13.	Topic 6 Dialogue Control Language – DCL Practical lesson 13. Dialog box with Button, Image_button and Edit_box text field. The purpose of the practical lesson is to study, using the AutoLISP and DCL functions, the operation of active fields defined by the Button button and the Edit_box text field. References: [2] pp. 115-116 ; [4] pp. 37-39 Tasks on the CTC . Develop a dialog box program in DCL with a Button, Image_button, and Edit_box text field. Provide for the use of the “ ok ” and “ cancel ” keys. Create a program for calling and closing the window in AutoLISP.	2
14.	Practical exercise 14. Dialog box with active drop-down list field Popup_list. The purpose of the practical lesson is to study, using the AutoLISP and DCL functions, the operation of the active field defined by the drop-down list Popup_list. References: [2] pp. 116-117 ; [4] pp. 39-40 Tasks on the SRS . Develop a dialog box program with a drop-down list field Popup_list. Provide for the use of the “ ok ” and “ cancel ” keys. Create a program for calling and closing the window in the AutoLISP language.	2
15.	Practical lesson 15. Development of a dialog box for setting formal drawing parameters. The purpose of the practical lesson is to learn, using the functions of the functional language AutoLISP and DCL, to execute dialog boxes for setting formal drawing parameters. References: [2] pp. 118-119 ; [4] pp. 40-41 Tasks on the SRS . Develop a dialog box program for setting formal parameters. Provide for the use of the “ ok ” and “ cancel ” keys. Create a program for calling, entering data, and determining changed values in the AutoLISP language.	2
	Total	30

6. Laboratory classes (computer lab)

According to the working curriculum, laboratory classes are not provided.

7. Student's independent work

Independent work of students takes 60% of the course study time, also includes preparation for the exam. The main task of independent work of students is to master scientific knowledge in the field of modern methods of calculating machines and apparatuses of chemical production, which are not included in the list of lecture questions, through personal search for information, the formation of active interest in a creative approach in educational work and in the performance of course work. In the process of independent work within the credit module, the student must learn to deeply analyze the problem of choosing effective methods of calculating apparatuses of chemical production and, based on calculations, come to his own substantiated conclusions.

No. of the com	Title of the topic to be studied independently	Number of hours of CTC
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1.	Topic 1. Overview of systems used for structural engineering Computer-aided design systems and life cycle products. Calculation and engineering analysis systems CAE. Design design systems CAD. Project data management systems PDM. Supply chain management systems SCM. Data management systems in the integrated information space CPC. Enterprise management systems ASUP, automated process control systems APCS. References: [1] pp. 3-24 ; [5] pp. 4-12;	4
2.	Topic 2. Composition and structure of systems for equipment design Specifics of information flows. Creation of information support. Basic requirements for information bases, information systems, interface, project modules (programs), users (designers). Information space , conceptual model, internal model. References: [5] pp. 37-42, [10] pp. 145-162	2
3.	Subsystems for users to master technologies implemented in CAD. Technical (TO), mathematical (MO), software (PO), information (IS), linguistic (LO), methodological, organizational (GO) support. References: [1] pp. 11-15; [10] pp. 41-43	2
4.	Information systems architecture. automated production control systems, automated technological process control systems, automated scientific research systems. Local and network systems for collective use, with the possibility of simultaneous access to data by several users. Literature: [1] pp . 16- 27	2
5.	Kernels to provide technology solid-state modeling. Basic concept AC cores AND S 3 D Geometrist and c Modele , Parasol and d , Th and nkdes and gn kernel , VX Overdrive , Open CASCADE , SML and b . Information retrieval systems. Targeted data processing and analysis systems. Factographic systems. Documentary systems. References: [1] pp . 1 9 - 27	6
6.	Topic 3. ASAD design system. Commands for executing and viewing drawings Program launch window. Launching the program using an existing drawing. AutoCAD program screen. Graphics window. External links management module. CAD Standards. Toolbar positions. Closing/Opening the toolbar. Command prompt window. Menu bar. AutoCAD input methods commands. Getting help. Size , shape and directions units of measurement. References: [5] pp. 9-14, [7] pp. 6-12	4
7.	Data entry field. Installation bindings , nets and parallelism. Rectilinear objects, polygons, point objects, Curvilinear objects, circles, ellipses. References: [5] pp. 15-28; [10] pp. 56-60; [7] pp. 19-32	2
8.	Selecting objects. Selecting using Window, Crossing, Window Polygon, Crossing Polygon, Fence, Previous, Last. Selecting a single object set. Selecting a block of objects. Editing, deleting, flipping, moving, copying, rotating, and scaling objects. References: [5] pp. 25-36; [7] pp. 33-48	4
9.	Dimension terminology. Linear dimensions. Horizontal and vertical dimensions. Dimensions using the keypoint selection method. Dimensioning using the object selection method. Associative dimensions. Parallel dimensions. Quick dimension. Arc	4

	length problems. Radius problems. Zigzag dimension. Diameter problems. Angular dimension problems. Dimension scale problems. Finding length and area. References: [5] pp. 37-41; [7] pp. 49-52	
10.	Working with text. Entering text. Single-line text. Compound line (creating text in paragraphs). Editing text. Finding and replacing text. Scaling text. Aligning text. Text style. Spell checking. Controlling text display. Inserting tables. Editing text. Modifying tables. References: [5] pp. 45-56; [7] pp. 54-63	2
11.	Topic 4. Features and tools of 3D modeling Construction planes and coordinate systems. Coordinates in three- dimensional space. Level and height. Coordinate systems. Tools for creating three-dimensional objects. Spirals and polylines. Construction of standard 3D bodies . Construction of a mesh. Dynamic creation of 3D bodies. Conversion of a planar object into a 3D body. Combination of 3D bodies. Editing 3D bodies. Sections, design. Three-dimensional editing. References: [3] pp. 63-71; [2] pp. 52-64	6
12.	Inserting and editing raster images. Importing from other formats, exporting to other formats. Planning the output of the drawing to the plotter. Sheet according to the template. Working with floating view screens. Changing the scale of views. References: [5] pp. 26-35; [7] pp.32-38	2
13.	Topic 5. AutoLISP functional language Studying the VL text editor . Graphic editor commands. Editor main menu. Toolbars. Compiling programs. Translating programs into the AutoCAD environment. Editing programs and correcting errors. Built-in and external functions. Functions for accessing primitives. Additional functions. Creating programs in the VL environment . References: [2] pp. 7-9 ; [3] pp. 89-95	4
14.	Editing programs and fixing errors. Built-in and external functions. Converting numbers to strings and checking data types. Primitive access functions. Additional functions. Creating programs in the VL environment . References: [10] pp. 14-18 ; [7] pp. 9-11; [2] pp. 36-40	4
15.	Special functions. System variables. Accessing primitives and devices. Special data types. Primitive name functions. Primitive attribute processing functions. Using primitive names and selection sets. References: [5] pp. 31-33 , [2] pp. 14-21 , [3] pp. 87-92	4
16.	Access to the screen and interactive devices. Functions for working with geometric descriptions of objects. Functions for working with objects. Functions for working with groups of commands References [5] pp. 35-37 , [2] pp. 22-25	2
17.	Special data types . Selection mode by frame, Polygon by secant line, secant polygon. Matching operators for filters. Determining the number of primitives in a set. Determining a specified primitive from a set. Removing primitives from a set and drawing. References: [2] pp. 26-29; [3] pp. 122-129	2
18.	Structure of a graphical database. Data recording format for creating and editing primitives by entering data into a graphical database. Attribute processing functions. Primitive names in selection sets. Access to table elements and on-screen interactive devices . References: [2] pp. 31-34; [3] pp. 129-131	2

19.	<i>VISUAL LISP functions for working with the Windows registry : vl-registry-write , vl-registry -read , vl-registry-delete , vl-registry-descendents . Functions for working with directories and files vl-directory-files vl-file-copy vl-file-delete vl-file-rename vl-filename-directory.</i> <i>References: [2] pp. 34-38; [12] pp.51-63</i>	2
20.	<i>Visual LISP functions for defining variables in AutoLISP: vl-acad-defun, vl-acad-undefun, vl -i n i t . Possibilities and methods of using the function for working with lists, strings, and symbols in the world.</i> <i>References: [2] pp. 39-42; [3] pp.142-148; [12] pp.63-71</i>	5
21.	<i>Possibilities and methods of using the function for working with the geometric description of objects made using 3D modeling. Study the structure of the object's "methods" and its details. The ability to use group commands in the current AutoCAD session. REACTOR types and the reaction function (callback function) that define the scenario.</i> <i>References: [2] pp. 42-48; [3] pp. 150-156</i>	4
22.	Topic 6. Dialogue Control Language – DCL <i>Predefined active fields. Predefined active field groups. Decorative and information fields. Defined attributes. DCL file structure. DCL language syntax. Dialog box management. AutoLISP functions for dialog boxes. Opening and closing DCL files. Opening and closing dialog boxes. Initializing action expressions and callback functions. Processing – fields and attributes. Assigning list and drop-down list fields. Creating images. Application-related data. Control function call diagram. Calling from the exsample.dcl file.</i> <i>References: [2] pp. 85-98; [3] pp. 203-229</i>	10
23.	<i>Expressing actions. Temporarily closing dialog boxes. Initializing field modes and values. Setting list and drop-down list fields. Processing list values. Processing images. Inserting an image button. Processing sliding scales.</i> <i>References: [2] pp. 99-112; [3] pp.230-237</i>	7
24.	<i>Preparation for the modular test</i>	4
25.	<i>Exam preparation</i>	30
	Total hours	120

Policy and control

8. Educational component policy

Rules for class attendance and behavior in class

Attendance is a mandatory component of assessment. Students are required to actively participate in the learning process, not be late for classes or miss them without a valid reason, not interfere with the teacher conducting classes, and not be distracted by activities unrelated to the learning process.

Rules for assigning incentive and penalty points

- *Incentive points can be awarded by the teacher exclusively for performing creative works that correspond to the work program or for additional completion of online specialized courses with the receipt of the corresponding certificate:*
 - <https://3dmaster.ru/autodesk-certificate/> ;
 - <http://autodesk.omgtu.ru/index.php/90-annotatsiya-kursov/107-yazyk-autolisp> ;
 - <https://siit.co/courses/autocad-course-and-certification/7> ;
 - <https://unit-edu.ru/courses/detail.php?ID=800>;

- <http://www.caddsoftsolutions.com/AutoLISP.htm> .

But their sum cannot exceed 25% of the rating scale.

- penalty points within the educational component are not provided.

Deadline and rescheduling policy

In case of arrears on the educational component or any force majeure circumstances, students must contact the teacher via available (provided by the teacher) communication channels to resolve problematic issues and agree on an algorithm of actions for practice.

Academic Integrity Policy

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the lack of references when using printed and electronic materials, quotes, opinions of other authors. Hints and copying when writing tests, conducting classes are unacceptable; taking credit for another student ; copying materials protected by the copyright system without the permission of the author of the work.

The policy and principles of academic integrity are defined in Section 3 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". More details: <https://kpi.ua/code>

Academic Conduct and Ethics Policy

Students should be tolerant, respect the opinions of others, formulate objections in a correct form, and provide constructive feedback in class.

The norms of ethical behavior of students and employees are defined in Section 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". More information: <https://kpi.ua/code>

9. Types of control and rating system for assessing learning outcomes (RSO)

Distribution of study time by types of classes and tasks in the educational component according to the working curriculum:

Semester	Study time		Distribution of teaching hours				Control measures		
	Loans	academic year	Lectures	Practical	Lab work	CRC	MKR	RR	Semester control
1	6.0	180	30	30	–	130	1	–	exam

Student rating for the educational component consists of the points he receives for:

A student's rating for a credit module consists of the points he receives for work in practical classes and for MCR.

Rating (weighting) points system and evaluation criteria

1. Performing practical work.

Weighted score – 2.7. The maximum number of points for all practical work is:

2.7 points x 15 points/year = 40 points

Criteria for assessing student knowledge

Mark	Completeness of the answer
2-2.7	Timely and complete completion of the task, preparation of all programs, calculations, registration and protection without flaws
1-2	Minor flaws in the programs that do not affect the calculation results
0.5-1	Untimely completion of the task, shortcomings in programs, calculations and design
0	Failure to complete the task

2. Completion of modular test work.

Weighted score –5. The maximum number of points on the modular test is:

5 points x 1 MCR = 5 points

Criteria for assessing student knowledge

Mark	Completeness of the answer
5	Timely and complete completion of the task, preparation of all programs, calculations, registration and protection without flaws
4	Minor flaws in the programs that do not affect the calculation results
3-2	Untimely completion of the task, shortcomings in programs, calculations and design
1-0	Failure to complete the task

Penalty and incentive points:

1. modernization of laboratory facilities (+2...+5) points
2. development of didactic course material (+2...+5) points

Thus, the semester rating scale for the educational component is:

$$RC = R_{pz} + R_{mkr} + R_{zao} = 40 + 5 + (+5) = 50 \text{ points}$$

The exam component is 50% of R:

$$Rekz = 50 \text{ points}$$

Thus, the rating scale for the educational component is:

$$R = RC + Rekz = 50 + 50 = 100 \text{ points}$$

The maximum sum of points for the starting component is 50 points. A prerequisite for admission to the exam is the completion of all practical classes and a starting rating of at least 34 points.

According to the results of the academic work in the first 7 weeks, the "ideal student" should score 29 points. At the first certification (8th week), the student receives "passed" if his current rating is at least 14 points.

According to the results of the academic work, the "ideal student" should score 50 points in 13 weeks of study. At the second certification (week 14), the student receives a "pass" if his current rating is at least 25 points.

In the exam, students complete a written exam paper. Each task contains 3 questions. The questions are rated at 10, 25 and 15 points . respectively. Question evaluation system:

- "excellent", complete answer (at least 90% of the required information) – 25-24 points;
- "good", sufficiently complete answer (at least 75% of the required information or minor inaccuracies) – 23-15 points;
- "satisfactory", incomplete answer (at least 60% of the required information and some errors) – 14-11 points;
- "unsatisfactory", unsatisfactory answer – 0 points.

The sum of the starting points and the points for the examination work is converted into the examination grade according to the table.

Number of points	Rating
95 ...100	perfectly
85 ...94	very good
75...84	good
65 ...74	satisfactorily
60...64	enough
RD <60	unsatisfactorily
Admission conditions not met	not allowed

10. Additional information on the educational component

Approximate list of questions that are put forward for the modular test

1. Input-output functions used in the program, their structure and application.
2. Mathematical functions used in the program, their application.

3. *Calling programs from AutoCAD.*
4. *Input-output functions in programs written in AutoLISP.*
5. *Mathematical functions.*
6. *Functions for working with the geometric description of an object.*
7. *Arrays (sets) of data in AutoLISP. Their structure.*
8. *Functions for selecting variables from a data set.*
9. *Commands for executing 3D designs in AutoCad.*
10. *Calling AutoCAD commands from AutoLISP.*
11. *Determining the characteristics of a 3D structure.*
12. *Data type checking functions.*
13. *List functions.*
14. *Image control functions.*
15. *Predefined active fields.*
16. *Predefined active field groups.*
17. *DCL language syntax.*
18. *Dialog exit buttons*
19. *Initializing action expressions and call functions with return.*
20. *Processing fields and attributes.*
21. *List and drop-down list field assignments.*
22. *Data related to the software application.*
23. *Functions prohibited during the dialog window.*
24. *Opening and closing dialog boxes.*
25. *Initializing action expressions and calling functions with return.*
26. *Creating images in a dialog box.*
27. *Temporarily close dialog boxes.*
28. *Dialog box management functions.*
29. *Opening and closing DCL files.*
30. *Field and attribute processing functions.*
31. *Decorative and informational fields.*

Approximate list of questions submitted for semester control

1. *Formulate the purpose and use of design engineering systems.*
2. *Explain what software complexes are, and the relationship of design systems to lower- and higher-level systems.*
3. *List and explain the stages of work in structural engineering.*
4. *List and explain the objects of design.*
5. *List and explain the requirements for structural design systems.*
6. *Explain the specifics of designing standard equipment in chemical engineering.*
7. *Explain the problem of synthesis of the structure of design systems.*
8. *Explain the types of design system support.*
9. *Explain the features of organizing software packages.*
10. *Formulate the basic principles of creating design systems.*
11. *List and explain the types of computer-aided design systems.*
12. *Explain what problems arise when a person works with CAD.*
13. *What modern systems are used for automated design, and indicate their features.*
14. *List the systems for performing strength calculations and indicate their features.*
15. *What systems exist for performing drawing and graphic work, and indicate their features.*
16. *Describe the functions that provide access to primitives in the functional language AutoLISP.*
17. *Explain the meaning of active fields and active field groups in the dialog control language – DCL.*
18. *What AutoLISP functions are used to open and close dialog boxes?*
19. *Explain the meaning and action of the dialog exit keys and the action expression keys.*
20. *How to manage decorative and information fields in dialog boxes in AutoLISP.*

21-42. Develop a program in the functional language AutoLISP to construct the drawing shown in the figure.

Question 1	Question 2	Question 3
Question 4	Question 5	Question 6
Question 7	Question 8	Question 9
Question 10	Question 11	Question 12

Question 13	Question 14	Question 15
Question 16	Question 17	Question 18
Question 19	Question 20	Question 21
Fragments of detail drawings		

43-54. Using the dialog control language – DCL, develop a program fragment to build a dialog box and enter values.

Question 1	Question 2	Question 3

Лабораторна робота N1 Параметры T1 0.000 T2 Значения T3 0.000 0.000 T4 0.000 Ok Cancel	Лабораторна робота N1 Параметры T1 Значения T2 0.000 0.000 0.000 T5 0.000 Ok Cancel	Лабораторна робота N1 Параметры 0.000 0.000 Значения 0.000 0.000 T4 0.000 0.000 T5 0.000 Ok Cancel
Question 4	Question 5	Question 6
Лабораторна робота N1 Параметры 0.000 T4 Значения 0.000 0.000 T5 0.000 T6 Ok Cancel	Лабораторна робота N1 Параметры Значения 0.000 0.000 T1 0.000 T2 0.000 T4 0.000 0.000 T6 Ok Cancel	Лабораторна робота N1 Параметры 0.000 0.000 0.000 0.000 0.000 Значения T3 T4 T6 Ok Cancel
Question 7	Question 8	Question 9
Лабораторна робота N1 Параметры 0.000 0.000 0.000 T2 0.000 T4 Значения 0.000 0.000 T6 Ok Cancel	Лабораторна робота N1 Ok Cancel Параметры T1 0.000 0.000 0.000 Значения T4 0.000 0.000 T5 0.000	Лабораторна робота N1 Ok Cancel Параметры Значения T1 0.000 0.000 T3 T4 0.000 0.000
Question 10	Question 11	Question 12
Лабораторна робота N1 Ok Cancel Параметры Значения T2 0.000 0.000 T4 T5 0.000 T6 0.000	Лабораторна робота N1 Параметры 0.000 0.000 T1 T3 0.000 0.000 0.000 Ok Cancel	Лабораторна робота N1 Параметры 0.000 0.000 0.000 T1 T3 0.000 0.000 0.000 Ok Cancel
Question 13	Question 14	Question 15

Лабораторна робота №1 Параметры 0.000 0.000 0.000 Значения S11 0.000 0.000 0.000 T2 T1 Ok Cancel	Лабораторна робота №1 Параметры 0.000 0.000 T1 T2 T3 Значения DL 0.000 0.000 0.000 Ok Cancel	Лабораторна робота №1 Ok Cancel Параметры T1 0.000 Значения T3 0.000 0.000 T4 0.000 0.000 0.000
<i>Question 16</i>	<i>Question 17</i>	<i>Question 18</i>
Лабораторна робота №1 Параметры 0.000 0.000 G11,G22 0.000 0.000 0.000 0.000 T1 T3 Ok Cancel	Лабораторна робота №1 Ok Cancel Параметры T1 0.000 0.000 T3 Значения T5 0.000 T6 0.000 0.000	Лабораторна робота №1 Параметры 0.000 0.000 vinvuz T1 T3 0.000 0.000 0.000 Ok Cancel
<i>Question 19</i>	<i>Question 20</i>	<i>Question 21</i>
<i>Dialog boxes for entering values</i>		

Work program of the educational component (syllabus):

Compiled by Prof., Doctor of Engineering Sciences, Shcherbina V.Yu.

Approved by the department CPSM (protocol no. 17 from 04.06.2025)

Approved by the Methodological Commission of the Faculty of Chemical Engineering (Minutes No. 11 from 27.06.2025)