



COMPUTER-INTEGRATED TECHNOLOGY FOR TECHNOLOGICAL EQUIPMENT DESIGN

Educational component work program (Syllabus)

Educational component requirements

Level higher education	Master 's degree
Branch knowledge	<i>G - Engineering, Manufacturing and Construction</i>
Specialty	<i>G11 Mechanical Engineering</i>
Educational program	<i>OPP Engineering of innovative industry equipment</i>
Status educational component	<i>Required</i>
Form teaching	<i>full-time (day)</i>
Year of preparation,	<i>1st year, fall semester</i>
Amount educational component	<i>4(120)</i>
Semester control/ control measures	<i>Test</i>
Schedule classes	<i>3 hours on week (1 hour lecture and 2 hours practical classes)</i>
Language teaching	<i>Ukrainian</i>
Information about the course leader / teachers	<i>Lecturer: Doctor of Technical Sciences, Professor Valerii Yuriyovych Shcherbyna, xpsm@ukr.net Practical work: Doctor of Technical Sciences, Professor Valerii Shcherbyna, xpsm@ukr.net</i>
Placing course	<i>Platform "Sikorsky"</i>

Educational component program

1. Description educational component, its goal, subject learning and results teaching

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

The main task of the educational component "Computer-integrated technologies for the design of technological equipment" is to form in higher education students systemic knowledge and practical skills in the application of modern CAD/CAE/CAM systems to automate the entire life cycle of technological equipment creation. At the same time, the methods of three-dimensional (3D) modeling of parts and assemblies, engineering calculations (CAE) for optimizing structures, and modeling technological processes are mastered.

One of the most pressing problems of modern mechanical engineering is to improve the quality and competitiveness of products by implementing high-tech solutions at all stages of design and production. This is possible with the comprehensive use of computer-integrated technologies, which allows not only to increase the efficiency and accuracy of design, but also to significantly reduce the time from idea to equipment manufacturing. Thanks to the thorough study of modern integrated software complexes, the future specialist can automate the execution of design and technological work, carry out multi-criteria optimization of design and processes, and also create digital twins of objects for the effective use of design systems and preparation for equipment production.

Subject of the educational component " Computer-integrated technologies for designing technological equipment " – 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.

Ability to adapt and act in a new situation ZK05.

Ability to generate new ideas (creativity) ZK06.

Ability to identify, pose, and solve problems ZK07.

Ability to make informed decisions ZK08.

Ability to work in a team ZK09.

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:

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

Prepare for production and operate equipment and products of industrial mechanical engineering throughout the life cycle of PRN07

Using the fundamental laws of conservation and transfer, select/develop/analyze/implement in CAD systems and other application programs mathematical models and regulations of processes occurring in the workspace and/or in the structures of technological equipment to solve problems of scientific research, design, operation, and modernization of industrial mechanical engineering equipment PRN12

2. Prerequisites and post-requisites educational component (place in structural-logical scheme teaching according to the relevant educational program)

The study of the educational component **"Computer-integrated technologies for the design of technological equipment "** 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 foundations of thermal engineering", "Mechanics of a deformed solid", "Technological foundations of mechanical engineering", "Modern methods of calculating processes and devices", "Processes, devices and machines of the industry".

3. Content of the educational component

Topic 1. Software as a design tool at product lifecycle stages

Topic 2. Integration of software modules in technological equipment design systems

Topic 3. Using computer software systems for equipment design

Topic 4. "VESNA" systems. Integration with the AutoCAD software environment

Topic 5. Using artificial intelligence technologies in computer-integrated systems

4. Educational materials and resource

Basic literature

- 1 Shcherbyna V.Yu. Design of equipment. Lecture notes [Electronic resource] / Igor Sikorsky Kyiv Polytechnic Institute. Kyiv, 2018. – 83 p. URL: <http://ela.kpi.ua/handle/123456789/25669>
- 2 Shcherbyna V.Yu., Gondlyakh O.V., Chemerys A.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>
- 3 Shcherbyna V.Yu., Stepanyuk A.R. Shell-and-tube heat exchangers. 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 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>
- 5 Automation 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.
6. CAD. Application of the VESNA software complex in calculations of processes and equipment taking into account thermal power loads. / V.Yu. Shcherbyna, O.S. Sakharov, V.I. Sivetsky, O.V. Gondlyakh Textbook Kyiv, Publishing House "EKMO", 2014. – 218 p.
7. Shcherbyna V.Yu., Leleka S.V., Bezverkhy I.O. Design methodology. Laboratory practical [Electronic resource] / Igor Sikorsky Kyiv Polytechnic Institute. Kyiv, 2024. 119 p. URL: <https://ela.kpi.ua/handle/123456789/67997>
- 8 Policy on the use of artificial intelligence for academic activities at Igor Sikorsky Kyiv Polytechnic Institute. <https://ela.kpi.ua/server/api/core/bitstreams/70b895b5-1339-4d51-975b-a6114035c950/content>

Additional literature

- 9 Shcherbyna V. Yu. Lecture course "Design methodology". - Kyiv: Publishing house "EKMO", 2010. – 168p.
- 10 Grabchenko A. I., Dobroskok V. L. Modern technologies of materialization of computer models. Kh.: NTU "KhPI", 2009. 86 p.
- 11 Gondlyakh O.V., Sakharov O.S., Sivetsky V.I., Shcherbyna V.Yu. CAD. APROKS software complex in calculations of machines and devices of chemical production. K.: Polygraph Consulting LLC, 2006, 136 p.
12. ABAQUS/CAE User's Guide. <http://desktop-5sfjnrn:2080/v6.14/index.html>
13. SOLIDWORKS 2018. Learn by doing - Part 1: parts, assembly, drawings, and sheet metal. Tutorial Books, 2018. 532 p.

Information resources on the Internet

- 14 Website of personal learning systems of KhNEU named after S. Kuznets. – <http://www.ikt.hneu.edu.ua/Quick-R> [Electronic resource]. – Access mode: <http://www.stat-methods.net/index.html>.
15. SiteSearch [Electronic resource]. – Access mode: <http://finzi.psych.upenn.edu/nmz.html>.
16. Rtips. Revival 2014! [Electronic resource]. – Access mode: <http://pj.freefaculty.org/R/Rtips.html>.
17. Statistics with R [Electronic resource]. – Access mode: http://zoonek2.free.fr/UNIX/48_R/all.html.
18. The Comprehensive R Archive Network [Electronic resource]. - Access mode: <http://cran.r-project.org>.
19. <https://docs.langchain.com> LangChain docs home
- 20 <https://arxiv.org/abs/2302.13971> LLaMA: Open and Efficient Baseline Language Models
21. <https://arxiv.org/abs/2005.11401> Retrieval-Augmented Generation for Knowledge-Intensive NLP Tasks

5. Methodology for mastering the educational component

Lectures occupation directed on:

- granting modern, whole, interdependent knowledge from the educational component "Computer-integrated technologies for the design of technological equipment", the level of which is determined by the target installation to each specific topics;
- software in process lectures creative works students together with teacher;
- 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;
- definition of the current level of development of science and technology in the field of computer-integrated technologies designing technological equipment;
- reflection of the methodical processing of the material (highlighting the main ideas and provisions, underlining conclusions, repetition their in different wording);
- acquisition visual, combination on opportunities with demonstration audiovisual materials, layouts, models and samples;
- teaching clear and clear in language, clarification all newly introduced terms and concepts; accessibility for perception given audience.

No. salary	Name topics lectures and list main questions (list didactic means, link on literature and task on CPC)	Hours
1	Topic 1 Software as a design tool at product life cycle stages Computer-integrated technologies. Software at the stages of the equipment life cycle. Organization of information interaction of various computer-integrated systems. Terms and definitions. Organization of computer-integrated design systems. Literature: [1, 3, 9, 10]. Task on CTS . Modern computer-integrated systems (CIS) as the basis for automation of design, production and operation of technological equipment. CAD, CAM, CAE, PLM and other systems as a single digital environment.	2
2	Topic 2. Integration of software modules in technological equipment design systems Connection of modules in design systems. Requirements and design objects. Specifics of equipment design in mechanical engineering. Mathematical, technical, linguistic, software, information, methodological and organizational support of design systems. Basic principles of creating computer-integrated systems. Literature: [2, 4, 10]. Tasks on the SRS . General structure. Implementation of effective numerical algorithms in mathematical support. Basic provisions of software and linguistic support. Technical support.	2
3	Basic principles of creating design systems. Application software packages. Features of technology and requirements for design systems. Problems of human functioning and automated design systems. Implementation of design systems at enterprises. Literature : [2, 5, 11, 12]. Tasks on the VTS . Functional capabilities of application software packages, organization and requirements for design systems. Problems of human functioning in the "human-system" system. Problems of implementing design systems at enterprises.	2

5	Topic 3. Using computer software systems for equipment design Software systems as an integral part of the process of designing technological equipment in various industries. Strength calculation systems. Aerohydrodynamics problem solving systems. Structural design systems. Integrated design systems Literature: [7, 9]. Task on SRS . Information systems for strength design – ANSYS, ADAMS, Pro/ENGINEER, CATIA, LS-DYNA. Aerohydrodynamics – Star-CD, CFX, FLUENT, FlowVision, FLOW-3D. Structural design systems – AutoCAD, Genius, CADMECH, Autodesk Inventor, T-FLEX CAD. Integrated systems – SolidWorks, SolidEdge, Unigraphics, CADdy	2
6	Topic 4. "VESNA" systems. Integration with the AutoCAD software environment Structure of the computer-integrated system VESNA. Computing complex of the system. Design and analytical programs. Design and construction programs. Format records in arrays, size fields and their placement in machine recording, key attributes. Data storage method. Main, working and output data arrays. Graphical means of forming a calculation scheme and visualizing calculation results in AutoCAD . Literature : [2, 6]. Task on SRS . Implementation of integration of the VESNA system with the AutoCAD graphical environment. Ability to perform calculations in the VESNA system directly during the design process in AutoCAD. File types and formats ensure data compatibility between AutoCAD and the VESNA calculation kernel. Export of calculation results to formats for processing in MS Excel	4
7	Topic 5. Using artificial intelligence technologies in computer-integrated systems General information on the use of artificial intelligence (AI) technologies. Basic approaches and methods. The role of AI in the design of technological equipment. Examples of AI application in mechanical engineering. AI algorithms. Search for technical solutions. Risks and limitations of AI implementation. References : [7], p. 62-72; [8], p. 7-25. Tasks for the SRS. The concept of AI and its main types. History of development. AI algorithm for searching for technical solutions, text generation. Methods for checking the quality and reliability of information obtained using AI. Ethical and legal aspects of using AI.	2
8	Integration of AI into computer-integrated systems. Design of technological equipment. Basic AI methods used in CIS Technological preparation of production. Operation and maintenance. Product life cycle management (PLM). Possibilities of using local neural networks (on-device / edge AI). Development trends in the future. References : [19]; [20]; [21]. Tasks on the SRS. Main components of computer-integrated systems (CIS). Effectiveness of integrating AI into automated process planning (CAPP) systems. Advantages of using digital twins with AI elements. Integration of AI into existing PLM systems. Advantages of a hybrid approach in the development of intelligent CIS. Integration of AI with 3D printing for the design of complex structures.	2
	Total	16

Practical (seminar) classes

The main objective 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 classes are carried out in a computer classroom at using didactic tools and modern software departments HPSM.

Main tasks of the cycle classes:

- help students systematize, consolidate and deepen their knowledge theoretical in nature in modern methods calculation machines and devices chemical productions;
- to teach students techniques for solving practical problems, to promote the acquisition of skills and abilities to communicate the results of their own research to colleagues and the scientific community;
- to teach students work with scientific and reference literature and schemes;
- to develop the ability to learn independently, that is, to master methods, ways and techniques self-study, self-development and self-control.

No. of the compan	Title of the topic of practical classes and list of main questions (list of didactic software, link on literature and task on CPC)	Hours
1	Topic 2. Integration of software modules in technological equipment design systems Practical lesson 1. Acquaintance with linguistic provision computer-integrated system for designing technological equipment. fragments of structural components of body equipment. Construction of fragments of mechanical engineering structures. Development of methods for applying finite elements. Literature: [2, 6, 12]. Tasks on the SRS . Analysis of the object of study. Selection of structural fragments. Methods of applying finite elements, network density.	2
2	Practical lesson 2 . Construction of fragments of hull equipment structures in the AutoCAD system based on standard AutoCAD system commands . Develop a calculation scheme for calculating on strength. Literature: [2, 12]. Task on SRS . Build in systems AutoCAD design diagram of a cylindrical shell. Commands 3 DPOLY , LAYER , AUDIT .	2
3	Topic 3. Using computer software systems for equipment design Practical lesson 3. Mathematical model for calculating the strength of hull equipment based on the moment-free theory of shells. Introduction to the VESNA strength calculation system. Construction of fragments of hull equipment structures based on standard VESNA system programs. References : [6] pp. 28-29. Tasks on the CTC. Build a design diagram of a cylindrical shell.	2
4	Practical lesson 4. Familiarization with methods for setting boundary conditions and external loading in the VESNA system, methods for setting physical and mechanical properties. References : [6] pp. 30-34. Problem on SRS . Specify boundary conditions and external load for a cylindrical shell.	2
5	Practical lesson 5. Familiarization with methods of processing and visualizing the received information. Construction of NDS graphs, tables, determination of critical load zones, failure elements. Literature : [6] pp. 62-66. Tasks on the SRS. Strength limit, determination of strength criteria for metallic and brittle bodies. Criteria of Misis, Hoek-Brown, Balandin.	2

	Topic 4. "VESNA" systems. Integration with the AutoCAD software environment	
6	Practical lesson 6. Calculation of the screw press body. Determine the internal loads on the press body (internal pressure). Obtain the values of the reduced stresses in the body. Compare the permissible stresses with the obtained ones and draw conclusions about the operability. Determination of the SE with the maximum load and the node with the maximum deflection. Literature : [6] p.147-149. Tasks on the VTS. Execution of graphs of the main G1, G2, G3, reduced stresses and displacements. Compare the permissible stresses with the obtained ones. Conclusions on the operability of the press	2
7	Practical lesson 7. Calculation of the blade of a screw press mixer. Questions for the practical lesson: Determine the internal loads on the blade. Obtain the values of the reduced stresses. Compare the permissible stresses with the obtained ones and draw conclusions about the operability. Determination of the SE with the maximum load and the node with the maximum deflection. Literature : [6] p.143-144. Tasks on the SRS . Execution of graphs of the main G1, G2, G3, reduced stresses and displacements. Compare the permissible stresses with the obtained ones. Conclusions on the performance of the blade	2
8	Practical lesson 8. Strength calculation of a rotary kiln section. Develop a calculation scheme. Specify the load, physical and mechanical characteristics. Perform a strength calculation taking into account thermal force loads. Literature : [6], p.62-68, p.172-173. Task on the SRS. Using the numerical complex "VESNA" determine the stress-strain state (SSS) of the furnace body, reduced, permissible stresses. Make graphs of stresses and displacements. Make a conclusion about the operability. Determine the safety margin and possible zones of destruction.	2
9	Practical lesson 9. Calculation of the support station of a rotary kiln with determination of the optimal location of the support rollers. Develop a calculation scheme. Specify the load, physical and mechanical characteristics. Perform a strength calculation. Literature : [6], p. 87-92, p. 190-194. Problem on SRS . Using the numerical complex "VESNA" taking into account cyclic loads, determine the NDS and reduced stresses. Determine the optimal location of the support rollers to increase the service life of the furnace. Make a comparison with the basic design.	2
10	Practical lesson 10. Calculation of shaped refractory with determination of the effective size of the thermal insulation cell. Develop a calculation scheme. Specify the load, physical and mechanical characteristics. Perform a strength calculation taking into account thermal power loads. Literature : [6], p. 177-178, p. 197-198. Problem on SRS. Using the numerical complex "VESNA" determine the thermal state of a refractory with a heat-insulating cell. Specify the design of a refractory with the optimal size of a heat-insulating cell taking into account thermal efficiency and permissible stresses. Compare the reduction in energy consumption depending on the design of the refractory.	2

11	<i>Practical lesson 11. Calculation of a rotary kiln 4.5x80m with determination of the optimal thickness of the casing. Develop a calculation scheme. Specify the load, physical and mechanical characteristics. Perform a strength calculation taking into account thermal power loads.</i> Literature : [6], p. 142-143, p. 199-214. Task on the SRS . Using the numerical complex “VESNA” to determine the NDS of the rotary kiln. By changing the thickness of the casing according to the energy zones, determine the optimal thickness to reduce the metal content. Determine the performance and safety margin of the casing of the rotary kiln. Compare with the basic design.	2
12	Topic 5. Using artificial intelligence technologies in computer-integrated systems <i>Practical lesson 12. Using AI chatbots, analyze the results of the calculation of a 4.5x80m rotary kiln. Provide recommendations regarding optimization of the temperature regime and opportunities for increasing resource efficiency. Describe the results shown in graphs and tables of the obtained data.</i> References : [7], p. 76-78, 101-106. Task on VTS. Using the chatbots ChatGPT, Copilot, Gemini and Poe, determine the possibility of improving thermal efficiency and increasing resource efficiency. Generate a report on the results obtained. Analyze the results obtained by the chatbots and provide a conclusion in which to indicate which of them turned out to be the most effective, offering complete and meaningful answers.	4
13	<i>Modular test work.</i>	2
14	<i>Test</i>	2
	Total	30

6. Laboratory classes (computer workshop)

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

7. Independent work of a student/postgraduate student

Independent work takes up to 62% of the study time, including preparation for the test. The main task of students' independent work is to master scientific knowledge in areas, What not entered in list lecture questions by personal information search, formation of active interest in a creative approach in educational work. In the process of independent work within the educational component, the student must learn to deeply analyze modern approaches to the development and implementation of the latest technologies and innovations in the direction of their own research.

N o.	Name topics	Number of hours
1	Topic 1. Software as a design tool at product life cycle stages <i>Modern computer-integrated systems (CIS) as the basis for automation of design, production and operation of technological equipment. Software at the stages of the equipment life cycle. CAD, CAM, CAE, PLM and other systems as a single digital environment.</i> Literature: [1, 3, 9, 10].	6
2	Topic 2. Integration of software modules in technological equipment design systems <i>General structure. Implementation of effective numerical algorithms in mathematical support. Basic provisions of software and linguistic support. Technical support.</i> References: [2, 4, 10]	8
3	<i>Functional capabilities of application software packages, organization and requirements for design systems. Problems of human functioning in the "human-system" system. Problems of implementing design systems at enterprises.</i> References: [2, 5, 11, 12]	8

4	Topic 3. Using computer software systems for equipment design Design information support systems. Systems for strength calculation – ANSYS, ADAMS, Pro/ENGINEER, CATIA, LS-DYNA. Systems for solving aerohydrodynamics problems – Star-CD, CFX, FLUENT, FlowVision, FLOW-3D. Design systems – AutoCAD, Genius, CADMECH, Autodesk Inventor, T-FLEX CAD. Integrated systems – SolidWorks, SolidEdge, Unigraphics, CADdy. Literature: [9], c. 8-42; [7], c. 28-45.	6
5	Topic 4. "VESNA" systems. Integration with the AutoCAD software environment Implementation of integration of the VESNA system with the AutoCAD graphical environment. Ability to perform calculations in the VESNA system directly during the design process in AutoCAD. File types and formats ensure data compatibility between AutoCAD and the VESNA calculation kernel. Export of calculation results to formats for processing in MS Excel References: [2], p. 52-62 ; [6], p. 12-27	10
6	Functional capabilities of application software packages, organization and requirements for design systems. Problems of human functioning in the "human-system" system. Problems of implementing design systems at enterprises. Literature: [2] , c. 63 - 78 ; [5] , c. 105 - 115 ; [11, 12]	6
7	Topic 5. Using artificial intelligence technologies in computer-integrated systems The concept of AI and its main types. History of development. AI algorithm for searching for technical solutions, text generation. Methods for checking the quality and reliability of information obtained using AI. Ethical and legal aspects of using AI. References: [7], pp. 43-72 ; [8], pp. 7-25.	8
8	Main components of computer-integrated systems (CIS). Effectiveness of integrating AI into automated process planning (CAPP) systems. Advantages of using digital twins with AI elements. Integration of AI into existing PLM systems. Advantages of a hybrid approach in the development of intelligent CIS. Integration of AI with 3D printing for the design of complex structures. References: [19]; [20]; [21]	12
9	Preparation for MKR	4
10	Preparation for credit	6
	Total hours	74

Policy and control

8. Educational component policy

Regulations visiting classes and behavior on classes

Class attendance is a mandatory component of assessment. Students are required to take active participation in the educational process, not to be late on occupation and not miss them without a good reason, not to interfere with the teacher conducting classes, not to be distracted by activities that are not related with educational process.

Rules for assigning incentive and penalty points

- Incentive points can be awarded by the teacher exclusively for performing creative works or taking additional online specialized courses with obtaining relevant certificate:
 - <https://ipp.eng.unimelb.edu.au/for-students>;
 - <https://au.linkedin.com/in/innovation-practice-program-0a0180171> ;
 - <https://www.port.ac.uk/study/courses/beng-hons-innovation-engineering>;
 - Others courses can be enrolled by agreement with teacher.
- penalties points in are not provided within the educational component.

Deadline and rescheduling policy

In the event of arrears for 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 work-out.

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 rights, without permission author 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 "Kyiv Polytechnic Institute named after Igor Sikorsky". More details: <https://kpi.ua/code>

9. Types control and rating system evaluation results teaching (RSO)

Distribution educational time by species classes and tasks from the educational component:

Semester	Educational time		Distribution of training hours					Control events		
	Credit and	academic year	Lectures	Practical (seminar) Russia	Lab work	Ind. occupation	CRC	MKR	RR	Semester control
2	4	120	16	30	-	-	74	1	—	Test

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

Rating student with credit module consists of with points, What he receives by work in practical classes and modular control work.

Semester control is test.

Rating student with credit module consists of with points, What he receives by:

- 1. Implementation and protection 8 practical works;*
- 2. Implementation modular control work;*

Rating points system and evaluation criteria

1. Practical works

The weighted score for one practical work is 16 points, which are composed as follows: in the following way:

- Right done task with practical works – 10 mark;*
- On time (on occupation or in designed term teacher) done task – 3 mark;*
- Right decorated protocol task with impeccable design results processing task results – 2 mark;*
- Timely (on to the appropriate occupation with protection) protection laboratory works and full answer during defense – 1 mark;*

The maximum number of points R_{prakt} that a student can receive for completing all practical

work is: 16 points x 5 works = 80 points.

2. Modular control work

- The maximum number of points that a student can receive for completing a module control works R_{kmr} is equal to: 15 points.
 - "excellent", complete answer (at least 90% of the required information) – 16-13 points;
 - "very good", answer from 1-2 (at least 85% of the required information) 13-8 points;
 - "good", sufficiently complete answer (at least 75% of the required information or minor inaccuracies) – 8-7 points;
 - "satisfactory", incomplete answer (at least 70% of the required information and some errors) – 6-5 points;
 - "sufficient", incomplete answer (at least 60% of the required information and some gross errors) – 4-2 points;
 - "unsatisfactory", unsatisfactory answer – 0 points.

Penalty and bonus points:

- active work with correct answers in lectures and laboratory classes (5 or more correct answers in classes) (+ 1÷5) points.

Scale calculation (R)rating:

Sum weight points control events for semester is:

$$R_c = R_{practical} + R_{kmr} + R_{bonus} (penalty) = 80 + 15 + (+ 1 \div 5) = 100 \text{ points}$$

According to the results of the academic work in the first 7 weeks, the "ideal student" should score 30 points. At the first certification (8th week), the student receives "passed" if his current rating is at least 16 points.

Based on the results of 13 weeks of study, the "ideal student" should score 60 points. At the second certification (week 14), the student receives a "pass" if his current rating is at least 30 points.

The maximum sum of points from all control measures for the credit (practical work, modular control work) is 100. A prerequisite for admission to the credit is the submitted report on practical work. Students who have a rating of less than 30 points at the end of the semester are not allowed to take the credit.

Students who have scored $R_c = 60$ points or more per semester can receive credit automatically based on the points they have scored. Students who have not scored a semester rating of 60 points and have at least 30 points or students who wish to increase their scores in a credit module complete a written assignment.

The exam ticket contains 3 questions. The weighted score of each question is estimated as: 30+30+35= 95 points. In addition, if the answer to the ticket question contains a description of modern, innovative methods of information support for design, which the student could familiarize himself with when working with additional literature, another 1 to 5 points are added. Thus, the full answer of the "ideal student" can be estimated in

$$R_{score} = 30+30+35 + 5 = 100 \text{ points.}$$

Each question ticket is being evaluated in accordance to systems evaluation:

- "perfectly", full respond (not Less 90% necessary information) –35÷30 points;
- "very good", respond with 1÷2 inaccuracies (not Less 85% necessary information) –29÷24 points;
- "good", sufficiently complete answer (at least 75% of the required information or minor inaccuracies) –23÷15 points;
- "satisfactory", incomplete answer (at least 70% of the required information and some errors) – 14÷9 points;
- "sufficient", incomplete answer (at least 60% of the required information and some gross errors) – 8÷1 points;
- "unsatisfactorily", unsatisfactory respond – 0 points.

The sum of all rating points received in the R credit from the educational component is as follows:

$$R = 30 + 30 + 35 + 5 = 100 \text{ points}$$

The sum of the points from the educational component is converted into a grade according to the table:

<i>R</i>	<i>University scale</i>
95...100 points	Perfectly
85...94 points	Very good
75...84 points	Good
65...74 points	Satisfactorily
60...64 points	Enough
$R < 60$ points	Unsatisfactorily
If $r_c < 30$ points or other admission conditions are not met, exam	Unauthorized

10. Additional information with educational component

Approximate list questions, which are carried out on test and modular control work

1. Formulate the main objectives of the course "Computer-integrated technologies for the design of technological equipment."
2. Describe the main components of a computer-integrated system (CIS) and their role in the design of process equipment.
3. Describe what software is used to manage production processes.
4. Describe the main stages of designing technological equipment.
5. Explain the role of technical documentation during the design phase.
6. What defines a product life cycle information support system?
7. Give examples of graphic documents included in design documentation.
8. Explain the importance of computer systems in the design and engineering process.
9. Describe what software tools are used to manage production processes
10. Describe what software tools are used during the conceptual design phase.
11. Explain how data integration affects the quality of the final product.
12. What is the role of PLM systems in the design of technological equipment?
13. Indicate what functions CAD software performs during the design phase.
14. State the advantages of using CAM systems in preparation for production.
15. To reveal the role of CAE in the process of creating design documentation.
16. Describe what tasks are solved using MES and SCADA systems during product manufacturing.
17. Explain how CRM systems facilitate product implementation and operation.
18. Explain how IETM systems contribute to efficient maintenance and disposal of equipment.
19. What is the impact of automation on reducing the design time of technological equipment?
20. Explain the role of technical documentation during the design phase.
21. What is the importance of graphic documents in the process of designing machines and units?
22. To reveal the relevance of reducing the design time in modern mechanical engineering.
23. Describe how computer systems affect the productivity of designers.
24. Explain what a product life cycle is and what stages it includes.
25. What is the integration of processes in the information support system of the product life cycle?
26. Give examples of software used in different stages of the life cycle.
27. Describe how artificial intelligence technologies are applied at the stage of preparing a product for manufacturing.
28. What is the role of banks and databases in the functioning of computer-aided design systems?
29. Give examples of the functions performed by a computer at the stage of searching for fundamental design solutions.
30. Specify the main characteristics of a complex design object.
31. Explain the meaning of the concept of "human-machine system" in the context of design systems.

32. What are the specifics of designing technological equipment in mechanical engineering, in particular for mills and press machines?
33. Specify the main types of design system support and their purpose.
34. Explain the purpose of information support in design systems.
35. Formulate the requirements that modern design technologies must meet.
36. Explain why it is important to be able to gain design experience in computer-aided design systems.
37. What is the importance of adequacy and informativeness for the successful implementation of a design system?
38. What determines the possibility of integrating design systems into automated enterprise management systems (AEMS)?
39. Describe the main features of application software packages (APs) in computer-aided design systems.
40. Explain the difference between method-oriented and problem-oriented application software packages.
41. Describe how the principle of "autonomy of individual parts of the system" is implemented in the modular construction of CAD.
42. What is the essence of the iterative nature of design in automated systems?
43. Describe the main stages of preparing an enterprise for the implementation of an automated design system.
44. What determines the feasibility of creating an automated design system for a specific object?
45. Describe the main purpose of the integrated system "VESNA" in the context of designing technological equipment.
46. Give examples of objects that can be investigated using the "VESNA" system.
47. Explain the functions of the VESNA system preprocessor during the formation of the calculation model.
48. Formulate the main capabilities of the VESNA system processor when solving problems of hydrodynamics, thermal conductivity, and strength.
49. Describe how the geometric and physical characteristics of the model are entered into the VESNA preprocessor.
50. What is the concept of multi-fragmentation (quasi-regularity) of discrete models in the "VESNA" system?
51. Explain the purpose of the VESNA system postprocessor and methods for visualizing results.
52. Explain how to export calculation results into formats suitable for further processing in MS Excel.
53. Give examples of graphic visualization tools available in the postprocessor of the VESNA system.
54. What determines the need to integrate the VESNA system with the AutoCAD graphical environment?
55. Describe how the integration of the "VESNA" system with the AutoCAD graphical environment is implemented when creating a calculation model.
56. Explain why using AutoCAD as the main interface for the VESNA system is appropriate for designers in the field of chemical engineering.
57. What is the role of the AutoLISP language in ensuring interaction between the components of the VESNA system and the AutoCAD environment?
58. What determines the possibility of performing calculations in the "VESNA" system directly during the design process in AutoCAD?
59. Give examples of functions performed by the "VESNA" preprocessor through the AutoCAD interface when generating model geometry.
60. Specify what file types and formats ensure data compatibility between AutoCAD and the VESNA calculation kernel.
61. Explain how the visualization of calculation results (for example, a deformed model) is carried out in the AutoCAD environment using the "SPRING" modules.
62. Formulate the advantages of integrating "VESNA" with AutoCAD when generating design documentation based on the results of MFE analysis.
63. Describe how the AUDIT program uses AutoCAD graphic objects to verify the correctness of the construction of fragments of the design scheme.
64. Explain how integration with AutoCAD allows the designer to quickly adjust the geometry of the model and immediately restart the calculation in the VESNA system.
65. Explain how artificial intelligence technologies are transforming traditional CAD/CAM environments.
66. What is the essence of generative design, and what role does artificial intelligence play in it?
67. What determines the effectiveness of integrating machine learning into computer-aided process planning (CAPP) systems?
68. Identify the key benefits of using digital twins integrated with artificial intelligence technologies.
69. Formulate the main risks associated with integrating artificial intelligence into existing PLM systems.
70. What determines the prospects for using local (on-device) neural networks in industrial control systems?
71. Give examples of the use of computer vision for quality control at the stage of production of technological equipment.

72. State the advantages of a hybrid approach combining symbolic methods and machine learning in the development of intelligent CIS.
73. Describe how artificial intelligence helps optimize the energy consumption of technological equipment during its operation.
74. Explain how integrating AI with additive technologies (3D printing) opens up new possibilities for designing complex structures.
75. What is the role of artificial intelligence in providing continuous feedback between stages of the product life cycle?

Work program of the educational component (syllabus):

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Approved by the Methodological Commission of the Faculty of Chemical Engineering (Minutes No. 11 dated 06/27/2025)