National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"

Department
biomedical engineering

# Automated design systems

## Working program of basic discipline (Silabus)

| Requisites for basic discipline | |
|---|---|
| **Level of higher education** | ***First (bachelor's)*** |
| **Branch of knowledge** | *16 Chemical and Bioengineering* |
| **Specialty** | *163 Biomedical Engineering* |
| **Educational program** | *Medical Engineering* |
| **Discipline status** | *Mandatory discipline* |
| **Form of study** | *full-time / day / mixed / remote* |
| **Year of preparation, semester** | *3th course, autumn semester* |
| **The scope of discipline** | *4 ECTS credits / 120 hours* |
| **Semester control / Control measures** | *Test Work, Modular Test Work, Calculation and Graphic Work* |
| **Lessons schedule** | *According to the schedule on the site http://rozklad.kpi.ua/* |
| **Language of instruction** | *English* |
| **Information about course leader / teachers** | ***Lecturer:*** *Doctor of Technical Sciences, Associate Professor, Head Department of BME Shlykov Vladyslav Valentynovych, e-mail: v.shlykov@kpi.ua, Telegram: https://t.me/vshlykov*<br>***Practical:*** *Doctor of Technical Sciences, Associate Professor, Head Department of BME Shlykov Vladyslav Valentynovych, e-mail: v.shlykov@kpi.ua, Zoom: 716 114 6823, code 2021* |
| **Course placement** | *Platform «Sikorsky» - course «Automated design systems»* |

**Distribution of hours**

| Semester | Lectures | Practical | Laboratory | Independent Work |
|---|---|---|---|---|
| ***autumn semester*** | *26* | *28* | *18* | *48* |

**Curriculum of the discipline**

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

*The main purpose of the discipline "Automated Design Systems" is to form students' ability to solve specialized problems and practical problems of automated design of medical devices and information-measuring systems for medical purposes, which involves the use of software and hardware for designing mechanical components of medical devices and systems based on two- and three-dimensional computer-aided design and drawing systems.*

*The discipline "Automated Design Systems" studies the use of computer tools for computer-aided design and drawing, software for creating libraries of geometric elements of medical devices for computer-aided design systems.*

*Skills are required to study the discipline:*

1. *Technical means of automated design systems (software tools AutoCAD or FreeCAD);*
2. *Software tools for creating libraries of geometric elements (macros on C++, Python);*
3. *Analysis of mechanical components of medical devices by finite element method (FEM).*

***General competencies*** *(OPP was put into effect by the Rector's Order NON/ 89/2021 of 19.04.2021):*

***GC 1*** *- Ability to apply knowledge in practical situations.*
***GC 4*** *- Skills in the use of information and communication technologies.*
***GC 5 -*** *Ability to perform research at the appropriate level.*
***GC 8*** *- Ability to make well-grounded decisions.*
***GC 11*** *- Ability to evaluate and ensure the quality of work performed.*

***Special (professional) competencies*** *(OPP was put into effect by the Rector's Order NON/ 89/2021 of 19.04.2021):*

***PC 1*** *- Ability to use engineering software packages for research, analysis, processing and presentation of results, as well as for automated design of medical devices and systems.*
***PC 3*** *- Ability to study and apply new methods and tools for analysis, modeling, design and optimization of medical devices and systems.*
***PC 6*** *- Ability to effectively use tools and methods for analysis, design, calculation and testing in the development of biomedical products and services.*
***PC 10*** *- Ability to apply the principles of construction of modern automated control systems for the production of medical devices, their technical, algorithmic, informational and software support for solving professional problems.*
***PC 14*** *- Ability to perfect experiments according to specified technical and medical methods, perform computer processing, analysis and synthesis of the results.*

***The program learning outcomes after studying the discipline "Microprocessor Engineering" are*** *(OPP was put into effect by the Rector's Order NON/ 89/2021 of 19.04.2021):*

***PLO 2 -*** *Possession of engineering methods for calculation of elements of devices and systems of medical use and a choice of classical and newest constructional materials.*
***PLO 5 -*** *Knowledge of research methods and techniques used in the design of medical equipment.*
***PLO 16 -*** *Application of modern programming technologies and tools that support their use.*
***PLO 25 -*** *Formulation of logical conclusions and substantiation of recommendations for evaluation, operation and implementation of biotechnical, medical-technical and bioengineering means and methods.*
***PLO 31 -*** *Understanding of theoretical and practical approaches to the creation and management of medical equipment and medical technic.*
***PLO 38 -*** *Ability to set tasks for the development of automated control systems taking into account the capabilities of modern hardware and software for automation of medical equipment.*
***PLO 40 -*** *Use of computer-aided design systems for development of technological and hardware scheme of medical devices and systems.*
***PLO 45 -*** *Improving the technical elements of medical devices and systems and medical products in the process of professional activity.*

## 2. Prerequisites and postrequisites of the discipline (place in the structural and logical scheme of education according to the relevant educational program)

*The discipline "Automated Design Systems" belongs to the cycle of professional training and has an interdisciplinary nature. It integrates knowledge from other disciplines according to its subject: engineering and computer graphics, object-oriented programming, etc. According to the structural and logical scheme of the bachelor's program, the discipline is closely related to other disciplines of general and professional training: "Physics", "Analytical Geometry", "Engineering and Computer Graphics", "Fundamentals of Informatics", "Materials and Construction Materials".*

*The acquired practical skills and acquired theoretical knowledge during the study of the discipline "Automated Design Systems" can be used later in the study of elective disciplines: "Biomedical devices, apparatus and complexes", "Examination and engineering support of medical equipment", "Fundamentals of design and medical equipment design".*

## 3. The content of the discipline

*The main sections and topics that will be considered in the process of studying the course:*

***Section 1. Fundamentals of automation of design of units of medical devices and systems.***

*Subject 1.1. Automated design methodology.*

*Subject 1.2. Stages of CAD development and design tools.*

***Section 2. Automation of design of units of medical devices and systems.***

*Subject 2.1. Automation of design of mechanical units of medical devices and systems.*

*Subject 2.2. Automation of design of information and measuring systems for medical purposes.*

***Section 3. Interface, capabilities and settings of system FreeCAD.***

*Subject 3.1. General characteristics of the automation design systems.*

*Subject 3.2. Working with layers. Object binding and tracking modes.*

***Section 4. Construction, editing and properties of drawing objects.***

*Subject 4.1. Apply and edit text, tables and hatching.*

*Subject 4.2. Drawing and editing sizes. Drawing templates.*

***Section 5. Creating and using blocks.***

*Subject 5.1. Working with bitmaps of objects.*

*Subject 5.2. Printing drawings. Exchange of information with other CAD.*

***Section 6. Fundamentals of work in three-dimensional space.***

*Subject 6.1. Creating simple spatial primitives.*

*Subject 6.2. Editing spatial objects.*

***Section 7. Frame and surface models.***

*Subject 7.1. Two- and three-dimensional frame and surface models.*

*Subject 7.2. Layout of models. Generation of types and sections.*

***Section 8. Create realistic images of objects.***

*Subject 8.1. Rendering and creating realistic images.*

*Subject 8.2. Libraries of geometric elements in C++ and Python.*

***Section 9. Analysis of components of medical devices by the finite element method (FEM).***

*Subject 9.1. Static analysis by finite element method.*

*Subject 9.2. Dynamic analysis by finite element analysis.*

*Subject 9.3. Nonlinear temporal dynamic analysis.*

## 4. Training materials and resources

***Basic literature:***


1. *Кравченко І. В. Основи САКР ОЕП: Навчальний посібник. [Електронний ресурс] / Укладач: І.В. Кравченко – НТУУ "КПІ". Електронні текстові дані. - Київ: НТУУ "КПІ", 2020 р.*
2. *Саєнко С. Ю. Основи САПР / С. Ю. Саєнко, І. В. Нечипоренко – Х. : ХДУХТ, 2017*
3. *Ли К. Основы САПР (CAD/CAM/CAE). – СПб.: Питер, 2004. – 560 с.*
4. *Наумчук О. М. Основи систем автоматизованого проектування. – Рівне : НУВГП, 2008.*
5. *Ванін, В.В. Комп'ютерна інженерна графіка в середовищі AutoCAD [Текст] / В.В. Ванін, В.В. Перевертун, Т.О. Надкернична. К.: Каравела, 2005. – 336 с.*
6. *Yorik van Havre and FreeCAD Com. A FreeCAD Manual. 2016. – 181 p.*

***Additional literature:***


1. *Кунву, Ли. Основы САПР (CAD/CAM/CAE) [Текст] / Ли Кунву. СПб.: Питер, 2004. – 560 с.*
2. *Погорелов, В.И. AutoCAD: Трехмерное моделирование и дизайн [Текст] / В.И. Погорелов. – СПб.: БХВ-Петербург, 2003. – 271 с.*
3. *Уроки по проектированию AutoCAD 2002-2005 [Текст] / И.В. Григорьев, Т.Н. Засецкая, М.И. Иванов, Е.П. Петрова [и др.]. М.: СОЛОН-Пресс, 2005. – 248 с.*
4. *ДСТУ 2226-93. Автоматизовані системи. Терміни та визначення: чинний від 1994-01-07. Офіц. вид. К. : Держстандарт України, 1994. 91с*
5. *ДСТУ ГОСТ 2.051:2006. Єдина система конструкторської документації. Електронні документи. Загальні положення. Чинний від 2007-01-07. Офіц. вид. К. : Держстандарт України, 2006. 17с.*
6. *ДСТУ ГОСТ 2.052:2006. Єдина система конструкторської документації. Електронна модель виробу. Загальні положення. Чинний від 2007-01-07. Офіц. вид. К. : Держстандарт України, 2006. 18с.*
7. *ДСТУ ГОСТ 2.053:2006. Єдина система конструкторської документації. Електронна структура виробу. Загальні положення. Чинний від 2007-01-07. Офіц. вид. К. : Держстандарт України, 2006. 17с.*


***Electronic resources:***

1. *The FreeCAD forum: http://forum.freecadweb.org*
2. *The source code of FreeCAD: https://github.com/FreeCAD/FreeCAD*
3. *The Facebook FreeCAD community: https://www.facebook.com/FreeCAD*
4. *The Google+ FreeCAD community: https://plus.google.com/u/0/communities/103183769032333474646*
5. *The FreeCAD documentation wiki: http://www.freecadweb.org/wiki*
6. *Translating FreeCAD on crowdin: https://crowdin.com/project/freecad*
7. *The FreeCAD bug tracker: http://www.freecadweb.org/tracker*

## Educational content

### 5. Methods of mastering the discipline (educational component)

| № s/n | Subject | Program learning outcomes | The main tasks | |
|---|---|---|---|---|
| | | | Control measure | Deadline |
| 1. | Fundamentals of automation of design of units of medical devices and systems. | PLO 5<br>PLO 40 | Practical work 1, 2<br>Laboratory work 1 | 3rd week |
| 2. | Automation of design of units of medical devices and systems. | PLO 2<br>PLO 40 | Practical work 3, 4<br>Laboratory work 2 | 4th week |
| 3. | Interface, capabilities and settings of system FreeCAD. | PLO 16<br>PLO 38 | Practical work 5, 6<br>Laboratory work 3 | 5th week |
| 4. | Construction, editing and properties of drawing objects. | PLO 16<br>PLO 31 | Practical work 7, 8<br>Laboratory work 4 | 6th week |
| 5. | Creating and using blocks. | PLO 5<br>PLO 40<br>PLO 45 | Practical work 9, 10<br>Laboratory work 5 | 8th week |
| 6. | Fundamentals of work in three-dimensional space. | PLO 16<br>PLO 40<br>PLO 45 | Practical work 11, 12<br>Laboratory work 6 | 9th week |

| | | | | |
|---|---|---|---|---|
| *7.* | *Frame and surface models.* | *PLO 38<br>PLO 40* | *Laboratory work 7* | *10th week* |
| *8.* | *Create realistic images of objects.* | *PLO 25<br>PLO 45* | *Laboratory work 8* | *11th week* |
| *9.* | *Analysis of components of medical devices by the finite element method (FEM).* | *PLO 2<br>PLO 5<br>PLO 16* | *Laboratory work 9* | *12th week* |
| *10.* | *Modular control work* | | *Practical work 13* | *13th week* |
| *11.* | *Calculation and graphic work* | *PLO 2<br>PLO 5<br>PLO 16<br>PLO 40<br>PLO 25* | *Registration and submission of work* | *13-14th week* |
| *12.* | *Test work* | | *Practical work 14* | *15th week* |

## 6. Independent student work

*One of the main types of semester control during the mastering of the discipline "Automated Design Systems" is the implementation of calculation and graphic work. Calculation and graphic work is performed in accordance with the requirements, within the period specified by the teacher.*

*The main purpose of computational and graphic work is to solve a practical problem using the material learned in lectures and independently, and practical skills acquired in practical work. The student can write calculation and graphic work only on the subject agreed with the teacher.*

***Approximate subject of calculation and graphic work:***

1. *Image management. Standard features.*
2. *"Mechanical" drawing capabilities.*
3. *Editing. Programming new types of primitives.*
4. *Design of drawings.*
5. *Static and dynamic blocks.*
6. *Element libraries.*
7. *Parameterization of elements.*
8. *Components.*
9. *Printing documents.*
10. *Interface programming.*
11. *Macros in Python.*

*The title page of the Abstract work should have the following content: the name of the university; name of the faculty; name of department; name of specialty, name of educational-professional program, name of academic discipline; topic of the abstract; surname and name of the student, course, number of the academic group, year.*

*The title page is followed by a detailed plan (content) of the Abstract work, which should highlight the introduction, sections of the main content (main topics studied), their subdivisions (if necessary), conclusion, list of sources used. The table of contents on the right indicates the page numbers at the beginning of each question. Each section begins on a new page.*

*The total volume of the Abstract work, depending on the chosen topic, can vary from 20 to 25 pages of the main text (in agreement with the teacher). The volume of the abstract is determined by the student's ability to concisely and at the same time comprehensively reveal the chosen topic.*

*Mandatory requirement: clear reference to sources of information. All figures, facts, opinions of scientists, quotations, formulas must have a reference in the form [2, p. 54] (the first digit means the number of the source in the list of references given at the end of the creative work, and the second digit -*

*the page number in this source). It is desirable to use tables, diagrams, graphs, charts, etc. The list of used sources (not less than 10 sources) is made out according to operating rules. If the information is taken from the Internet, you need, as for ordinary literature, to indicate the author, the title of the article, and then provide the address of the site on the Internet.*

*The Abstract work is evaluated by the following criteria: logic of the plan; completeness and depth of disclosure of the topic; reliability of the received data; display of practical materials; correct formulation of conclusions and conclusions; design; substantiation of the student's own opinion on this issue in the form of a conclusion.*

*Deadline for submission of Abstract work for review: 13-14th week of study.*

*The Abstract work is not tested for plagiarism, but must meet the requirements of academic integrity. In case of academic dishonesty, the work is canceled and not checked.*

## Policy and control

### 7. Policy of academic discipline (educational component)

***Attending classes***

*Attendance at lectures is optional. Attending practical classes is desirable, as they are used to write express tests / tests, as well as to defend practical work.*

*The grading system is focused on obtaining points for student activity, as well as performing tasks that are able to develop practical skills and abilities.*

***Control measures missed***

*Missed control measures (defense of practical work) must be practiced in the next classes, provided that the task is scheduled for the current lesson, or in consultations.*

*Omissions of writing a module test and express test are not fulfilled.*

*Calculation and graphic work, which is submitted for inspection in violation of the deadline is evaluated with a decrease in the number of weight points.*

***Violation of deadlines and incentive points***

| *Encouragement points* | | *Penalty points ** | |
|---|---|---|---|
| *Criterion* | *Weight points* | *Criterion* | *Weight points* |
| *Improving practical work* | *1 points (for each practical work)* | *Untimely implementation and test of practical work* | *From -0.5 points to -5 points (depending on the delivery date)* |
| *Passing distance courses on topics that are agreed with teachers* | *5 points* | *Untimely execution and test of calculation and graphic work* | *From -2 points to -20 points (depending on the construction period)* |
| *Registration of scientific work for participation in the competition of student scientific works* | *10 points* | | |
| *Writing abstracts, articles, participation in international, national and / or other events or competitions on the subject of the discipline* | *5 points* | | |

** if the control measure was missed for a good reason (illness, which is confirmed by a certificate of the established sample) - penalty points are not accrued.*

***Academic integrity***

*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". Read more:* https://kpi.ua/code.

***Norms of ethical behavior***

*Normative principles of behavior of students and employees, defined in sections 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". Read more: https://kpi.ua/code.*

***Procedure for appealing the results of control measures***

*Students have the opportunity to raise any issue related to the control procedure and expect it to be addressed according to predefined procedures.*

*The student has the right to appeal the results of the control measure according to the approved provision on appeals in the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (approved by the order №NON/128/2021 from 20.05.2021) - https://osvita.kpi.ua/index.php/node/182*

***Inclusive education***

*The discipline "Automated Design Systems" can be taught to most students with special educational needs, except for students with severe visual impairments who do not allow to perform tasks using personal computers, laptops and / or other technical means.*

***Distance learning***

*Distance learning takes place through the Sikorsky Distance learning Platform «Sikorsky».*

*Distance learning through additional online courses on certain topics is allowed subject to agreement with students. If a small number of students wish to take an online course on a specific topic, studying the material with such courses is allowed, but students must complete all the tasks provided in the discipline.*

*The list of courses is offered by the teacher after the students have expressed a desire (because the bank of available courses is updated almost every month).*

*The student provides a document confirming the completion of the distance course (in the case of a full course) or provides practical tasks from the distance course and subject to an oral interview with the teacher on the topics can receive grades for control measures provided for the studied topics (express control / test tasks, practical work).*

*Performance of practical works, and also performance of settlement and graphic work, is carried out during independent work of students in a remote mode (with a possibility of consultation with the teacher through e-mail, social networks).*

***Learning a foreign language***

*Teaching in English is carried out only for foreign students.*

*At the request of students, it is allowed to study the material with the help of English-language online courses on topics that correspond to the topics of specific classes.*

## 8. Monitor and evaluate the system of evaluation of learning outcomes (Rating System of Evaluation)

***Evaluation system (current control):***

| *№ s/n* | *Control measure* | *%* | *Weight points* | *Number* | *Total* |
|---|---|---|---|---|---|

| № s/n | Control measure | % | Weight points | Number | Total |
|---|---|---|---|---|---|
| 1. | Express control works / test tasks | 14 | 2 | 7 | 14 |
| 2. | Execution and test of practical works | 24 | 2 | 12 | 24 |
| 3. | Execution and test of laboratory works | 27 | 3 | 9 | 27 |
| 4. | Modular control work (MCW) | 15 | 15 | 1 | 15 |
| 5. | Abstract work (AW) | 20 | 20 | 1 | 20 |
| 6. | Test work[1] | 80 | 80 | 1 | 80 |
| | Total | | | | 100 |

*The applicant receives a positive credit score for the results of the semester, if he has a final rating for the semester of at least 60 points and has met the conditions of admission to the semester control, which are determined by the RSE (Rating System of Evaluation).*

*With applicants who have met all the conditions of admission to the test and have a rating of less than 60 points, as well as with those applicants who want to increase their rating, in the last scheduled lesson in the semester, the teacher conducts semester control in the form of test or interviews.*

*After performing the test, if the score for the test is higher than the rating, the applicant receives a score based on the results of the test.*

*If the grade for the test is lower than the rating, a "hard" RSE is used - the previous rating of the applicant (except for points for the semester individual task) is canceled and he receives a grade based on the results of the test. This option forms a responsible attitude of the applicant to the decision to perform the test, forces him to critically assess the level of his training and carefully prepare for the test.*

***Calendar control** (CC) - is performed twice a semester as monitoring of the current state of compliance with syllabus requirements.*

*The purpose of calendar control is to improve the quality of student learning and monitor the implementation of the schedule of the educational process by students.*

| Criterion | | | The first CC | The second CC |
|---|---|---|---|---|
| Deadline of calendar controls | | | 8th week | 14th week |
| Conditions for obtaining a positive result from the calendar control | Current rating | | ≥ 24 points | ≥ 40 points |
| | Execution practical work | PW № 1- 6 | + | + |
| | | PW № 7-12 | - | + |
| | Execution of laboratory works | LW № 1- 4 | + | + |
| | | LW № 5- 9 | - | + |
| | Express control works / test tasks | At least 4 of any lectures | + | - |
| | | At least 8 of any lectures | - | + |
| | Modular control work | Estimated MCW | - | + |
| | Abstract work | Estimated AW | - | - |

*In case of detection of academic poor quality during training - the control measure is not credited.*

### *Semester certification of students*

| Mandatory condition for admission to the test | Criterion |
|---|---|

[1] *Враховується в суму рейтингу разом з оцінкою за РГР у разі, якщо студент не набрав 60 балів за семестр або він хоче покращити свою оцінку.*

| | Mandatory condition for admission to the test | Criterion |
|---|---|---|
| 1 | Current rating | RD ≥ 42 |
| 2 | Obtaining a positive assessment for the performed Abstract work | More than 8 points |
| 3 | All practical works are tested | More than 14 points |
| 3 | All laboratory works are tested | More than 14 points |
| 4 | Writing at least 6 express tests / tests | More than 6 points |

*The results are announced to each student separately in the presence or remotely (by e-mail). Also recorded in the system "Electronic Campus".*

*Optional conditions for admission to closure:*

1. *Activity in practical classes.*
2. *Activity in laboratory classes.*
3. *Positive result of the first attestation and the second attestation.*
4. *Attending 50% of lectures.*

*Table of translation of rating points to grades on a university scale:*

| Number points | Assessment on the university scale |
|---|---|
| 100-95 | Perfectly / Відмінно |
| 94-85 | Very good / Дуже добре |
| 84-75 | Good / Добре |
| 74-65 | Satisfactorily / Задовільно |
| 64-60 | Enough / Достатньо |
| Less 60 | Unsatisfactorily / Незадовільно |
| Admission conditions are not met | Not allowed / Не допущено |

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

*The list of questions for preparation for modular control work, and also for preparation for credit is given in appendix 1.*

*Distance learning through additional online courses on certain topics is allowed subject to agreement with students. If a small number of students wish to take an online course on a specific topic, studying the material with such courses is allowed, but students must complete all the tasks provided in the discipline.*

*The list of courses is offered by the teacher after the students have expressed a desire (because the bank of available courses is updated almost every month).*

*The student provides a document confirming the completion of the distance course (in the case of a full course) or provides practical tasks from the distance course and subject to an oral interview with the teacher on the topics can receive grades for control measures provided for the studied topics (express control / test tasks, practical work).*

***Work program of the discipline (syllabus):***

***Compiled by*** *Associate Professor of Biomedical Engineering, Doctor of Technical Sciences, Shlykov Vladyslav Valentynovych, Head of the Department of Biomedical Engineering.*

***Approved by*** *the Department of Biomedical Engineering (protocol № ___ to _____)*

***Approved by*** *the Methodical Commission of the Faculty of Biomedical Engineering (protocol № __ to _____)*

*Appendix 1 to the syllabus of the discipline*

*"Automated Design Systems"*

***The list of questions for preparation for modular control work,***

***And also for preparation for test***

1. *Explain the concept of "engineering design"*
2. *What is the purpose of CAD in the design of complex technical facilities?*
3. *What is the place of CAD in modern production?*
4. *What are the main disadvantages and directions of CAD development?*
5. *Give examples of the main types of automated enterprise systems*
6. *How do you understand the expression - "Product life cycle"?*
7. *What are the features of the design of complex technical objects?*
8. *What stages of designing new complex technical objects do you know?*
9. *Analyse the composition, structure and classification of CAD.*
10. *What stages of project creation in CAD do you know?*
11. *What is the purpose of expert systems in CAD?*
12. *How are CAD integrated with other automated systems?*
13. *Define the purpose of CAE / CAD / CAM-systems, their functions and characteristics.*
14. *What typical design procedures in CAD do you know?*
15. *What is the role of the technical task in the design?*
16. *What are the tasks of structural optimization?*
17. *What are the tasks of parametric optimization?*
18. *Drawing and editing text, tables and hatching.*
19. *Drawing and editing sizes. Drawing templates.*
20. *Working with bitmaps of objects.*
21. *Exchange of information with other CAD.*
22. *Creating simple spatial primitives.*
23. *Editing spatial objects.*
24. *Two- and three-dimensional frame and surface and models.*
25. *Layout of models. Generation of types and sections.*
26. *Rendering and creating realistic images.*
27. *Libraries of geometric elements in Python.*
28. *Features of static analysis by the finite element method.*
29. *Features of dynamic analysis by the finite element method.*
30. *What are the parameters of nonlinear temporal dynamic analysis?*