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

Department of Biomedical Engineering

Theory of solving inventive problems

Syllabus of the academic discipline (Syllabus)

Course Details

Level of higher education	***First (bachelor's)***
Field of study	*16 Chemical and Bioengineering*
Specialty	*163 Biomedical Engineering*
Educational program	*Medical Engineering*
Course status	*Selective*
Mode of study	*Full-time (day)*
Year of study / semester	*4th year, 7th semester*
Course workload	*4 ECTS credit modules (120 hours), 26 hours – lectures, 28 hours – practical, 66 hours – independent work*
Forms of assessment	*Credit, MCR, Essay*
Course schedule	*According to the schedule on the website https://schedule.kpi.ua/*
Language of instruction	*Ukrainian*
Course Instructor(s)	*Senior Lecturer Ovcharenko Hanna Romanivna, ovcharenko.ganna@lll.kpi.ua*
Instructor profile	*http://bmi.fbmi.kpi.ua/department/staff-department/* *http://intellect.bmi.fbmi.kpi.ua/profile/ogr*
Course Delivery Platform	*https://do.ipo.kpi.ua/course/view.php?id=994*

Distribution of hours

semester	Lectures	*Practical*		*Laboratory*	*Independent wo*
fall semester	*26*	*28*			*66*

Course Programme

1. Course Description, Aim, Subject Matter and Learning Outcomes

The academic discipline "Theory of Inventive Problem Solving" belongs to the cycle of elective academic disciplines of professional training for bachelors, a cycle of disciplines for acquiring in-depth knowledge in the specialty. It is designed for bachelors in the fourth year of study.

The discipline forms a systematic approach that significantly increases the effectiveness of creative work and develops engineering thinking and approaches to the study of biomedical objects. In accordance with international educational programs, the theoretical content of the disciplines includes the study of methods for developing creative imagination and activating the solution of technical tasks, the differences between a problem and a task, the principles of setting and formulating tasks, which helps to identify the essence of the task and correctly determine the main directions of search, how to systematize the search for information, the principles of logical and systems thinking, the surrounding world as a system: technical, informational, biological and others, the laws of development of technical systems, the algorithm for solving inventive tasks, the basic principles of applying theory in technical and non-technical spheres.

The purpose of the discipline: the formation of a medical and engineering worldview based on generalized and systematized basic knowledge to train specialists capable of applying knowledge in practical situations, understanding the subject area of professional activity, using information and

communication technologies, processing and analyzing information from various sources, identifying, formulating and solving biomedical engineering problems.

Educational components are formed by a systematic approach, which significantly increases the effectiveness of creative work and develops engineering thinking and approaches to the study of biomedical objects.

Why can you learn?

Knowledge:

– practical methods of organizing and solving engineering problems of various levels of complexity

– ethical standards for performing engineering activities

– principles of information systematization

– the main trends and directions of development of medical technology and the corresponding labor market

skill:

– think systematically

– develop and apply creative abilities in professional activities

– apply knowledge of fundamental educational components to solve professional problems

– apply and accept criticism, including self -criticism

– defend your opinion with arguments

– analyze the current state and technological

– features of medical device manufacturing and biomedical engineering

When teaching an academic discipline, to activate the educational process, the use of modern educational technologies is envisaged, such as: problem lectures, "brainstorming". Also used are explanatory and visual problem presentation; partial-search and research methods, verbal, visual and practical methods; in practical classes, a partial-search, or heuristic method is used, which teaches the search for the right ways and methods of solving problems, reproductive and problem-search, cognitive games, educational discussions.

During training and for interaction with students, modern information, communication and network technologies are used, and an appropriate online course on the Sikorsky platform has been developed and is constantly being improved.

Integral competence

***IC** - The ability to solve complex specialized tasks and practical problems in biomedical engineering or in the process of learning, which involves the application of certain theories and methods of chemical, biological and medical engineering, and is characterized by the complexity and uncertainty of the conditions.*

*"Theory of solving inventive problems" strengthens the following **general competencies** (OP put into effect by the Rector's Order NOD/434/24 dated 06/10/2024):*

ZK 01 - Ability to apply knowledge in practical situations.

ZK 06 - Ability to search, process and analyze information from various sources.

GC 07 - Ability to generate new ideas (creativity).

*"Theory of Solving Inventive Problems" strengthens the following **professional competencies** (OP put into effect by the Rector's Order NOD/434/24 dated 06/10/2024):*

FC 03 – Ability to learn and apply new methods and tools for analysis, modeling, design, and optimization of medical devices and systems.

FC 09 – Ability to identify, formulate, and solve engineering problems related to the interaction between living and non-living systems.

*"Theory of Inventive Problem Solving" reinforces the following **program learning outcomes** after studying the discipline (OP put into effect by the Rector's Order NOD/434/24 dated 06/10/2024):*

PRN 01 - Apply knowledge of the basics of mathematics, physics and biophysics, bioengineering, chemistry, engineering graphics, mechanics, resistance and strength of materials, properties of gases and liquids, electronics, computer science, acquisition and analysis of signals and images,

automatic control, systems analysis and decision-making methods at the level necessary to solve biomedical engineering problems .
PRN 08 - Understand theoretical and practical approaches to the creation and management of medical equipment and medical technology.
PRN 09 - Understand theoretical and practical approaches to the creation and application of artificial biological and biotechnical objects and materials for medical purposes.
PRN 14 Be able to analyze the level of compliance with modern world standards, as well as evaluate solutions and formulate tasks for the development of automated control systems, taking into account the capabilities of modern technical and software tools for automating medical equipment.

2. Prerequisites and Postrequisites of the Course (place within the structural and logical framework of the educational programme)

The discipline is interdisciplinary in nature. It integrates, according to its subject, the basic characteristics and definitions of other educational and scientific branches of the profession: clinical engineering, bioengineering, biomechanics, biotechnology, bioinstrumentation , biomaterials science , biomedical cybernetics, medical terminology.

To study the discipline " Theory of Solving Inventive Problems ", knowledge of the historical course of the development of science and technology is necessary.

According to the structural and logical scheme, the bachelor's program is closely related to other disciplines of the professional block and disciplines of the language and practical training block.

The practical skills obtained and theoretical knowledge acquired while studying the academic discipline " Theory of Solving Inventive Problems " can be used in the future during pre-diploma practice and diploma design.

Required skills

1. *Knowledge of the historical development of science and technology*
2. *Knowledge of the basics of systems theory*
3. *Basic skills in identifying, formulating, and solving engineering problems related to the interaction between living and non-living systems.*

3. Course Content

Section 1. Theory of solution of inventive problems (TRVZ)
Topic 1. History of the TRVZ, purpose, tasks, functions.
Topic 2. Task: types, levels.
Topic 3. System: technical, informational, biological.
Topic 4. Laws of development of technical systems.
Topic 5. Algorithm for solving inventive problems, the concept of contradiction.
Topic 6. Methods for eliminating contradictions in the development of technical systems.
Topic 7. Methods for developing creative imagination and activating problem solving.
Topic 8. Methods of evaluating developments.

4. Learning Materials and Resources

Basic literature

1. *Melentyev O. B. Fundamentals of inventive activity: educational and methodological manual./ O. B. Melentyev; Ministry of Education and Science of Ukraine, Uman State Pedagogical University named after Pavlo Tychyna. – Uman: ALMI, 2023. – 244 p. ISBN 966-675-233-6*
Access mode: *https://cutt.ly/treuRCLA*
2. *Fundamentals of scientific creativity: a textbook / S. M. Prodashchuk , A. L. Kravets, G. E. Bogomazova, O. O. Shapatina . - Kharkiv: UkrDUZT , 2021. - 143 p.*
Access mode: *http://lib.kart.edu.ua/handle/123456789/7440*
3. *International scientific projects [Electronic resource]: a teaching aid for students of specialty 161 "Chemical technologies and engineering" / Igor Sikorsky Kyiv Polytechnic Institute; compiled by: B. Yu. Kornilovich , L. M.*

Spasyonova , O. Ya. Veselskaya . – Electronic text data (1 file: 1.32 MB). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2021. – 93 p.
Access mode: *https://ela.kpi.ua/handle/123456789/44384*

4. *Creation and improvement of technical systems: lecture notes / compiled by S. V. Sapozhnikov . – Sumy: Sumy State University, 2019. – 148 p.*
Access mode: *https://core.ac.uk/download/pdf/231769869.pdf*

Supporting literature

1. *Kuznetsov, Yu. M. Ukraine needs inventors and stimulation of invention / Kuznetsov Yu. M. // Creation, protection, defense and commercialization of intellectual property rights: collection of materials of the VI All-Ukrainian scientific and practical conference with international participation (Kyiv, April 26, 2023). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2023. – P. 33-40.*
Access mode: *https://ela.kpi.ua/handle/123456789/56767*

2. *Vazhinsky S.E., Shcherbak T.I. Methodology and organization of scientific research: Textbook . /S. E. Vazhinsky , T.I. Shcherbak. – Sumy: Sumy State University named after A.S. Makarenko, 2016. – 260 p. ISBN 978-966-698-223-3*
Access mode: *https://nuczu.edu.ua/sciencearchive/Articles/gornostal/vajinskii%20posibnyk.pdf*

Information resources

1. *Sikorsky Platform – https://do.ipo.kpi.ua/course/view.php?id=994*
2. *Information Service of Igor Sikorsky Kyiv Polytechnic Institute https://document.kpi.ua/*
3. *Faculty of Biomedical Engineering https://fbmi.kpi.ua*

The list of information resources includes their sources.

Educational content

5. Methodology for Studying the Course (Educational Component)

No.	Topic	Program learning outcomes	Main tasks	
			Control West	Term implementation
1.	Topic 1. History of TRVZ, the emergence of the theory in the 1940s, the formation of the theory in domestic practice, recognition of the theory at the international level, implementation of the principles of TRVZ into practice in leading companies producing various equipment, taking into account world standards. Purpose, tasks, functions of TRVZ.	PLO 1, 14	Practical work 1	1st week
2.	Topic 2. Task: types, levels. Differences between a problem and a task. Setting and formulating a task based on an understanding of scientific and technical principles, methods and research methods, approaches to the creation and application of artificial biological and biotechnical objects and materials for medical purposes, creation and management of medical equipment and medical technology	PLO 8, 9, 14	Practical work 2	2nd week
3.	Topic 3. System: technical, informational, biological: theoretical and practical approaches to the creation of medical equipment and technology, artificial	PLO 1, 8, 9, 14	Practical work 3	3rd week

No.	Topic	Program learning outcomes	Main tasks	
			Control West	Term implementation
	biological and biotechnical objects and materials for medical purposes.			
4.	Topic 4. Laws of TS development. Understanding the life cycles of technical systems to formulate logical conclusions and justify recommendations for the assessment, operation and implementation of biotechnical, medical-technical and bioengineering tools and methods.	PLO 1, 8, 9, 14	Practical work 4-6	Week 4-6
5.	Topic 5. Algorithm for solving inventive problems, the concept of contradiction. ARZ: main stages: determining the type of problem, formulating contradictions and ICR, assessing resources. Contradictions: basics of formulating contradictions of various levels based on knowledge of the basics of mathematics, physics and biophysics and decision-making methods at the level necessary to evaluate solutions and formulate tasks for the development and solution of biomedical engineering problems.	PLO 1, 14	Practical work 7-8	8-9th week
6.	Topic 6. Techniques for eliminating contradictions in the development of technical systems. Basic techniques, principles of their application. Main difficulties in applying techniques for solving inventive problems.		Practical work 9-11	Week 10-12
7.	Topic 7. Methods for developing creative imagination and activating problem solving for planning and designing new advances in biomedical engineering. Methods of brainstorming, focal objects, etc. Advantages and disadvantages of individual and group work methods.	PLO 14	Practical work 12	Week 13
8.	Topic 8. Methods of evaluating developments: analytical, operational, synthetic stages taking into account the set and formulated task based on an understanding of scientific and technical principles, methods and research methods, approaches to the creation and application of artificial biological and biotechnical objects and materials for medical purposes, creation and management of medical equipment and medical technology	PLO 1, 8, 9, 14	Practical work 13	Week 14
9.	MKR		Writing MCR	Week 15
10.	Test	During the final week		

6. Independent Student Work

One of the main types of semester control during the mastering of the academic discipline ***"Theory of Solving Inventive Problems"*** *is the completion of an essay. The essay is completed in accordance with the requirements, within the time specified by the teacher.*

The main goal of the essay is to master the material taught in lectures and independently study

theoretical material. A student can write an essay only on a topic agreed upon with the teacher.

Approximate topic of the Abstract:

1. *Application of engineering technologies to biological objects;*
2. *Application of engineering technologies to medical facilities.*
3. *Application of engineering technologies to inanimate objects.*
4. *Application of scientific approaches in organizing research work.*

Students can also propose and agree on their topic with the teacher.

The title page of the abstract should have the following content: name of the university; name of the faculty; name of the department; name of the specialty, name of the educational and professional program, registration number, name of the academic discipline; topic of the abstract; surname and name of the student, course, academic group number, year. The title page is followed by a detailed plan (table of contents) of the abstract, which should include the introduction, sections of the main content, conclusion, and list of sources used. The table of contents indicates the page numbers of the beginning of each question on the right. Each section begins with a new page.

The total length of the essay, depending on the chosen topic, can vary from 18 to 20 pages. The length of the essay is determined by the student's ability to concisely and at the same time comprehensively reveal the topic: the relevance of the topic under consideration, current trends and problems, analyze the best foreign and Ukrainian technologies, draw conclusions and substantiate their own proposals and recommendations.

The abstract is accompanied by an abstract in two languages – Ukrainian and English, indicating the keywords.

Mandatory requirement: clear reference to sources of information. All figures, facts, opinions of scientists, quotes, formulas must have references in the form of [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 is the page number in this source). It is advisable to use tables, diagrams, graphs, charts, etc. The list of sources used (at least 10 sources) is drawn up in accordance with current rules. If the information is taken from the Internet, it is necessary, as for ordinary literature, to indicate the author, the title of the article, and then give the address of the site on the Internet.

The essay is evaluated according to the following criteria: logical plan; completeness and depth of disclosure of the topic; reliability of the data obtained; display of practical materials and calculation results; availability of illustrations (tables, figures, diagrams, screenshots of web pages, etc.); number of sources used and clarity of references to them; design; substantiation of the student's own opinion on this issue in the form of a conclusion.

Deadline for submitting an essay for review: 17th week of study.

The abstract is checked for plagiarism using public resources and must meet the requirements of academic integrity. If academic dishonesty is detected, the work is canceled and not checked .

Policy and control

7. Course Policy (Educational Component)

Attending classes

Attendance at lectures is not mandatory. Attendance at practical classes is desirable, as they include writing express control papers/tests, and also defense of practical papers.

The assessment system is focused on receiving points for student activity, as well as completing tasks that can develop practical skills and abilities.

Missed control measures

Missed tests (practical work defense) must be made up in the following classes, provided that the task scheduled for the current class or consultations is completed. Missed module tests and express tests are not made up.

An essay submitted for review after the deadline is evaluated with a reduced number of weighted points.

Violation of task deadlines and incentive points

Incentive points	
Criterion	*Weighted score*
Participation in scientific and scientific-innovative activities (with the provision of relevant documents)	*5 points*
Taking distance courses on topics agreed upon with teachers	*5 points*

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". More information: https://kpi.ua/code.

Norms of ethical behavior

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 .

Procedure for appealing the results of control measures

Students have the opportunity to raise any issue related to the examination procedure and expect it to be addressed according to predetermined procedures.

The student has the right to appeal the results of the control measure in accordance with the approved regulations on appeals at Igor Sikorsky Kyiv Polytechnic Institute (approved by order No. HOH/128/2021 dated 05/20/2021) - https://osvita.kpi.ua/index.php/node/182

Inclusive learning

Academic discipline "Theory of solving inventive problems" for most students with special educational needs, except for students with severe visual impairments that prevent them from completing tasks using personal computers, laptops, and/or other technical aids.

Distance learning

Distance learning takes place through the Sikorsky Distance Learning Platform.

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

The list of courses is offered by the teacher after students express their desire (since the bank of available courses is updated almost every month).

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

Practical work, as well as modular test work, can be carried out during independent work of students in remote mode (with the possibility of consulting with the teacher via email, social networks).

Learning in a foreign language

Teaching in English is provided only for foreign students.

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

8. Types of Assessment and Rating System for Learning Outcomes (RSLO)

Evaluation system (current control):

No. salary	Control measure	%	Weighted score	Ring	Total
1.	Reports at seminar classes;	24	12	2	24
2.	Participation in discussions during practical/seminar classes	8	1	8	8
3.	Report on work in practical classes	10	2	5	10
4.	Modular test work	12	12	1	12
5.	Abstract	46	46	1	46
	Total				100
6.	Credit work[1]	54	54	1	54

In accordance with the rating system for assessing student learning outcomes, the 100-point scale of grades in the discipline is distributed:

Block I – the applicant's points obtained for studying section 1 and amounts to 54 points (items 1-4);

Block II – the applicant's points received for the Essay and amounts to 46 points (point 5);

Calculation of points for presentation in seminar classes (item 1)

Rating	Evaluation criterion	Points
"Perfectly"	The illustrative material (presentation) fully, with high clarity, reveals the main provisions of the work presented in the report. The material was created using modern graphic packages in compliance with the requirements of regulatory documents.	9 points
"Very good"	The illustrative material (presentation) fully, but with insufficient clarity, reveals the main provisions of the work. The material was created using modern graphic packages, there are minor deviations from the requirements of regulatory documents.	8 points
"Good"	The illustrative material (presentation) fully, but with insufficient clarity, reveals the main provisions of the work. The material was created using modern graphic packages, there are deviations from the requirements of regulatory documents.	7 points
"Satisfactorily"	The illustrative material (presentation) does not fully and clearly reveal the main points of the work. The material was created using modern graphic packages, there are significant deviations from the requirements of regulatory documents.	6 points
"Enough"	The illustrative material (presentation) does not fully and clearly reveal the main points of the work. The material was not created using modern graphic packages, and there are significant deviations from the requirements of regulatory documents.	5 points
"Not satisfactory"	Does not meet the "Satisfactory" criterion	0 points

[1] *It is taken into account in the total rating along with the grade for the essay if the student did not score 60 points for the semester or if he wants to improve his grade.*

Calculation of points for a report in seminar classes (item 1)

Rating	Evaluation criterion	Points
"Perfectly"	*The applicant clearly and fully disclosed the goal of the work, the ways to achieve it, and thoroughly substantiated the decisions made. The answers to the questions demonstrate the applicant's ability to professionally defend their own point of view.*	*3 points*
"Very good"	*The applicant clearly and fully disclosed the purpose of the work, the ways to achieve it, deeply argues the decisions made, but makes minor errors and assumptions. The answers to the questions are essentially correct, but not always sufficiently complete and reasoned.*	*2.5 points*
"Good"	*The applicant clearly and fully disclosed the purpose of the work, the ways to achieve it, deeply argues the decisions made, but makes mistakes and assumptions. The answers to the questions are correct in essence, but not sufficiently complete and reasoned.*	*2 points*
"Satisfactorily"	*The report on the work is essentially correct, but it is constructed illogically and unclearly. The answers to the questions are incomplete, and inaccuracies are assumed in the reasoning behind the decisions made.*	*1.5 points*
"Enough"	*The report on the work is essentially correct, but it is constructed illogically, unclearly, and has many omissions. The answers to the questions are incomplete, and significant inaccuracies are assumed in the reasoning behind the decisions made.*	*1 point*
"Not satisfactory"	*Does not meet the "Satisfactory" criterion*	*0 points*

Calculation of points for the Abstract (item 5)

Rating	Evaluation criterion	Points
"Perfectly"	*At least 95% of the necessary information. The material was created using modern graphic packages in compliance with the requirements of regulatory documents.*	*46-43 points*
"Very good"	*At least 85% of the required information. The material was created using modern graphic packages in compliance with the requirements of regulatory documents.*	*39-42 points*
"Good"	*At least 75% of the required information. The material was created using modern graphic packages in compliance with the requirements of regulatory documents.*	*35-38 points*
"Satisfactorily"	*At least 65% of the required information. The material was created using modern graphic packages in compliance with the requirements of regulatory documents.*	*31-34 points*
"Enough"	*At least 60% of the required information. The material was created using modern graphic packages in compliance with the requirements of regulatory documents.*	*28-30 points*
"Not satisfactory"	*Does not meet the "Satisfactory" criterion*	*0 points*

Assessment is carried out in accordance with the Regulations on the system of assessment of learning outcomes at Igor Sikorsky Kyiv Polytechnic Institute https://osvita.kpi.ua/node/37

The results are announced to each student individually in the presence of the control event or remotely (by e-mail, in the "Sikorsky" system). They are also recorded in the "Electronic Campus " system.

The applicant receives a positive credit score based on the results of work in the semester if he has a final rating for the semester of at least 60 points and has fulfilled the conditions for admission to semester control, which are determined by the RSO.

With applicants who have met all the admission conditions for the credit and have a rating score of less than 60 points, as well as with those applicants who wish to increase their rating score, at the last scheduled lesson in the discipline in the semester, the teacher conducts a semester control in the form of a credit test or interview.

After completing 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 score for the credit test is lower than the rating, a "hard" RSO is applied – the applicant's previous rating (with the exception of the scores for the semester individual assignment) is canceled and he receives a grade taking into account the results of the credit test. This option forms a responsible attitude of the applicant to making a decision about taking the credit test, forces him to critically assess the level of his preparation and carefully prepare for the test.

***Calendar control** (CC) - is carried out twice a semester as a monitoring of the current status of implementation of the syllabus requirements . The purpose of calendar control is to improve the quality of student learning and monitor the implementation of the educational process schedule by students.*

Criterion			First Criminal Code	Second Criminal Code
Calendar control period			8th week	Week 14
Conditions for obtaining a positive result from calendar control	Current rating		≥ 1 points	≥ 15 points
	Performing practical work	PR No. 1-2	+	+
		PR No. 3-7	-	+

If academic dishonesty is detected during studies, the test will not be counted.

Semester certification of students

Mandatory condition for admission to the exam		Criterion
1	Having a positive grade for the Abstract	More than 28 points

The results are announced to each student individually in person or remotely (by e-mail). They are also recorded in the "Electronic Campus " system.

Optional conditions for admission to the exam:

1. *Activity in practical classes.*

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

Number of points	Rating for university scale
100-95	Perfectly
94-85	Very good
84-75	Good
74-65	Satisfactorily
64-60	Enough
Less than 60	Unsatisfactorily
Admission conditions not met	Not allowed

9. Additional Course Information (Educational Component)

A list of questions for preparing for the module test, as well as for preparing for the exam, is provided in Appendix 1.

Distance learning through additional online courses on a specific topic is permitted subject to

agreement with students. If a small number of students wish to take an online course on a specific topic, studying the material through such courses is permitted, but students must complete all tasks provided for in the academic discipline.

The list of courses is offered by the teacher after students express their desire (since the bank of available courses is updated almost every month).

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

The working program of the academic discipline (syllabus):

Compiled *by senior lecturer of the Department of Biomedical Engineering Ovcharenko Hanna Romanivna*

Approved *by the Department of Biomedical Engineering (Minutes No. 16 dated 06/21/2024)*

Approved *by the Methodological Commission of the Faculty of Biomedical Engineering (minutes No. 9 dated 06/26/2024)*

Additional Course Information (Educational Component)

Appendix 1 to the discipline syllabus

" Theory of solving inventive problems "

List of questions to prepare for the module test, and also for preparation for the test

Block I

1. *Analyze the history of the formation of the theory of the 1940s-1970s. The founder of the theory and his main works.*
2. *Analyze the history of the formation of the TRVZ at the end of the 20th century. Creation of the "Smart Machine". International TRVZ Association.*
3. *Analyze the development of TRVZ in the 21st century. Introduction of TRVZ in the training of specialists in domestic and foreign educational institutions.*
4. *Explain the main purpose and functions of the TRVZ. Analyze the possibility of applying the TRVZ in various areas of scientific and practical activity.*
5. *Explain the four basic principles of TRVZ. Give examples of their application in theory.*
6. *Explain the concept of "system". Describe the features of a technical system. Give examples of technical and non-technical systems, analyze their differences.*
7. *Explain the concepts of "ideal end result", "ideal technical system", "ideal substance", "ideal form", "ideal process". Give examples.*
8. *Explain the concept of ARZ and describe its main stages: defining the type of problem, formulating the contradiction and ICR, and assessing resources. Give examples.*
9. *Explain the concept of contradiction: superficial, deep, acute. Give examples.*
10. *Describe the structure of the ARVS: analytical, operational, synthetic stages. Give examples.*
11. *Describe the levels of tasks according to the TRVZ and analyze their differences. Give examples.*
12. *Formulate typical errors in problem formulation and analyze ways to eliminate them. Give examples.*
13. *Analyze the "life cycle" of a technical system and its relationship to the laws of technical system development. Give examples.*
14. *Analyze modern technical systems that are at the stage of "childhood", "maturity", and "old age", respectively.*
15. *Using the example of a technical system, describe the laws of statics in the development of technical systems.*
16. *Using the example of a technical system, describe the laws of dynamics in the development of technical systems.*
17. *Using the example of a technical system, describe the laws of kinematics in the development of technical systems.*
18. *Methods of activating creative imagination. Advantages and disadvantages of individual and group work methods.*
19. *Analyze the main difficulties in applying methods for solving inventive problems.*
20. *Analyze the main difficulties in assessing the effectiveness of TRVZ developments.*

Block II

The second block will contain questions related to methods for solving inventive problems. Each question will contain one method that must be described using the example of changing a certain technical system.

1. *Using the example of improving a certain technical device, demonstrate the application of the following techniques: two of the forty basic techniques will be presented below.*