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

Department of Mathematical Analysis and Theory Probability

Higher Mathematics. Part 2. Differential and Integral Calculus of Functions of Many Variables, Differential

Work program for the credit module of the academic discipline "Higher Mathematics. Part 2. Differential and Integral Calculus of Functions of Many Variables, Differential" (Syllabus)

Details of the academic discipline

Level of higher education First (bachelor's)

Field of knowledge	17 Electronics, Automation, and Electronic Communications
Special	172 Electronic communications and radio engineering
Educational program	**1. Intelligent technologies of radio electronics** **2. Information and Communication Radio Engineering** **3. Radio Engineering Computerized Systems** **4. Radio Electronic Warfare Technologies**
Status of the discipline	Regulatory
Form of study	Full-time (day)/distance
Year of training, semester	1st year, spring semester
Scope of the discipline	210 hours (54 hours – Lectures, 54 hours – Practical lessons, 102 hours – Independent study)
Semester assessment/assessment measures	Exam/written exam
lesson schedule	http://rozklad.kpi.ua
Language of instruction	Ukrainian

Information about the course supervisor/lecturers	Lecturer: Alexander Dykhovichny, PhD, Associate Professor of the Department of Mathematical Analysis and Probability Theory,a.dyx@ukr.net , mobile +38(067)9005262 **Practical**: Volodymyr Pavlenkov, PhD, Senior Lecturer, Department of Mathematical Analysis and Probability Theory, pavlenkovvolodymyr@gmail.com Maslyuk Anna Oleksiyivna, Candidate of Physical and Mathematical Sciences, Senior Lecturer, Department of Mathematical Analysis and Probability Theory, masliukgo@ukr.ne Yuriy Pavlovich Butsenko, Candidate of Physical and Mathematical Sciences, Associate Professor of the Department of Mathematical Analysis and Probability Theory, armchairdoc@ukr.net
Course location	https://campus.kpi.ua

Curriculum

1. Description of the academic discipline, its purpose, subject matter, and learning outcomes

Description of the discipline	According to the curriculum, the credit module "Higher Mathematics. Part 2. Differential and Integral Calculus of Functions of Several Variables, Differential Equations" is part of the academic discipline "Higher Mathematics" (ZO 7), belongs to the cycle of mathematical and natural science training, and is of paramount importance in the training of specialists. It is necessary for the successful mastery of special disciplines. This credit module is based on the knowledge students have acquired while studying mathematics in secondary school, as well as the credit module "Higher Mathematics. Part 1." The discipline "Higher Mathematics" is one of the fundamental general education disciplines that form the theoretical basis for the training of engineers and programmers. The knowledge and skills acquired by students while studying this discipline are used in the further study of many subsequent disciplines in the professional training of specialists with basic and complete higher education. When taking this discipline, students will learn: the basics of integral calculus of functions of one and many variables, elements of field theory, and ordinary differential equations. In practical lessons, they will master methods for solving basic problems from all sections. The course includes quality control of the knowledge gained in the form of Module test s and homework assignments.

Course objectives	The objectives of the course are: • to develop in of education logical thinking, developing their intellect and abilities; • the formation of the necessary intuition and erudition in the application of mathematics, the cultivation of applied mathematical culture; • the formation of abilities to independently use and study literature on mathematics, develop flexibility thinking, creative independence, and action.
Subject of the academic discipline	General mathematical properties and patterns. Definite integrals, fundamentals of differential calculus of functions of several variables, fundamentals of integral calculus of several variables, elements of field theory, and ordinary differential equations.
Competencies	The aim of the course is to develop students' abilities: • ability to think abstractly, analyze, and synthesize (GC 1); • ability to apply knowledge in practical situations (GC 2);
	• the ability to learn and master modern knowledge (PC 07); • ability to identify, pose, and solve problems (PC 08);
Program learning outcomes	Apply fundamental and applied sciences to analyze and develop processes occurring in telecommunications and radio engineering systems (PLO13).

2. **Prerequisites and post-requisites of the discipline (place in the structural-logical scheme of training under the relevant educational program)**

Post-requisites: OK "Higher Mathematics" is part of the cycle of mathematical and natural science training and is of paramount importance in the training of specialists and precedes OK "Computer Science" and "Programmable Tools in Intelligent Radio Electronics."

3. Contents of the academic discipline

Title of sections and topics	**Number of hours**			
	Total	**including**		
		Lectures	**Practical**	**SRC**
1	**2**	**3**	**4**	**-**
KRZ-1	2	-	2	**-**
Section 1. Definite integral				
Topic 1. Definite integral	24	8	6	10
Total for Section 1	**24**	**8**	**6**	**10**
Section 2. Differential calculus of functions of several variables				

Topic 2. Differential calculus of functions of several variables variable	28	10	10	8
Test on sections 1 and 2	8	–	2	6
Total for section 2	**36**	**10**	**12**	**14**
Section 3. Integral calculus of functions of several variables. Elements of field theory				
Topic 3. Multiple, curvilinear, and surface integrals integrals. Vector analysis.	52	20	16	16
Test on Section 3	6	–	2	4
Total for Section 3	**58**	**20**	**18**	**20**
Section 4. Ordinary differential equations				
Topic 4. Differential equations	46	16	14	16
Test on Section 4	4	–	2	2
Total for Section 4	**50**	**16**	**16**	**18**
Calculation work	10	–	–	10
Exam	30	–	–	30
Total hours	**210**	**54**	**54**	**102**

Teaching materials and resources Basic literature

1. Mathematics at a Technical University: Textbook./ I.V. Alekseeva, V.O. Gaidei, O.O. Dykhovichnyi, L.B. Fedorova; edited by O.I. Klesov; Igor Sikorsky Kyiv Polytechnic Institute, - Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2019. – Vol. 2. – 504 p.
https://ela.kpi.ua/handle/123456789/30396
2. Mathematics at a Technical University: Textbook./ I.V. Alekseeva, V.O. Gaidei, O.O. Dykhovichnyi, L.B. Fedorova; edited by O.I. Klesov; Igor Sikorsky Kyiv Polytechnic Institute, - Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2020. – Vol. 3. – 454 p.
https://ela.kpi.ua/handle/123456789/39003
4. Dubovyk V.P. Higher Mathematics / V.P. Dubovyk, I.I. Yurik. — Kyiv: Ignatex-Ukraine, 2013. — 648 p.
4. Ovchinnikov P. P. Higher Mathematics: In 2 parts. Part 2 / P. P. Ovchinnikov. — Kyiv: Tekhnika, 2004. — 792 p.
5. Adams R. A. Calculus: Complete Course / R. A. Adams, C. Essex. — Toronto: Pearson Canada, 2010. — 1076 pp.

Supplementary literature

6. Zill D. G. Advanced engineering mathematics / D. G. Zill, W. S. Wright. — Burlington : Jones and Bartlett Learning, 2017. — 1004 pp.
7. Zill D. G. Calculus: Early Transcendentes / D. G. Zill, W. S. Wright. — Sudbury: Jones and Bartlett publishers, 2011. — 994 pp.
8. All Higher Mathematics / M. L. Krasnov, A. I. Kiselev, G. I. Makarenko et al. — Moscow: Editorial URSS, 2017. — Vol. 2—4.
9. Pismenny D. Lecture notes on higher mathematics: Complete course / D. Pismenny. —

Moscow: Iris Press, 2014. — 608 p.
10. Mathematics at a technical university: Practical exercises: In 4 parts /
I. V. Alekseeva, V. O. Gaidei, O. O. Dykhovichnyi, L. B. Fedorova. — Kyiv: NTUU
KPI, 2014. — 752 p.
11. Berman G. N. Collection of problems on the course of mathematical analysis /
G. N. Berman. — St. Petersburg: Lan, 2017. — 492 p.

Information resources Distance learning courses:

1. Mathematics for Engineers and Economists. Integral Calculus of Functions of One Variable. Course for Bachelors of Technical and Economic Specialties. Lectures, practical lessons, video lectures. Alekseeva I.V., Gaidey V.O., Dykhovichny O.O., Fedorova L.B., Konovalova N.R., Dudko A.F., Moskvichova K.K.

http://moodle.ipo.kpi.ua/moodle/course/view.php?id=1249

2. Mathematics for engineers and economists. Multiple, curvilinear, and surface integrals. Course for bachelor's degree students in technical and economic specialties. Lectures, practical lessons, video lectures. Alekseeva I.V., Gaidey V.O., Dykhovichny O.O., Konovalova N.R., Fedorova L.B., Dudko A.F., Moskvichova K.K.

https://do.ipo.kpi.ua/course/view.php?id=15

3. Mathematics for engineers and economists. Elements of field theory Course for bachelor's degree students in technical fields. Lectures, practical lessons. Alekseeva I.V., Gaidey V.O., Dykhovichny O.O., Konovalova N.R., Fedorova L.B.

https://do.ipo.kpi.ua/course/view.php?id=361

4. Mathematics for engineers and economists. Differential equations Course for bachelor's degree students in technical and economic specialties. Lectures, practical lessons, video lectures. Alekseeva I.V., Gaidey V.O., Dykhovichny O.O., Konovalova N.R., Fedorova L.B., Dudko A.F., Moskvichova K.K.
https://do.ipo.kpi.ua/course/view.php?id=237

Educational content

1. Methodology for mastering the academic discipline (educational component) Full-time/distance learning

Lectures

No	Lecture topic and list of key questions (list of teaching aids, references to literature, and assignments for independent study)
1	Definite integral over an interval and its properties. Problems leading to the concept of a definite integral. The concept of a definite integral as the limit of integral sums. Theorem on sufficient conditions for the integrability of a function. Properties of a definite integral. *Recommended literature:* [2], section 9.6.
2	Methods for calculating definite integrals: Newton-Leibniz formula, substitution of variables, and integration by parts. Integration of even and odd functions. *Recommended reading:* [2], section 9.7.
3	Applications of definite integrals: calculating the areas of plane figures, volumes of solids of revolution, and volumes of solids with known cross-sections. *Recommended reading:* [2], section 9.9.
4	Improper integrals of the first and second kind: from a bounded function over an unbounded interval and from an unbounded function over a bounded interval. The concept of convergence and divergence of improper integrals Comparison theorems *Recommended reading:* [2], section 9.8.
5	Functions of several variables. Domain of definition. Limit of functions of several variables. Continuity of functions multivariablevariables. Properties of functions continuous in a closed domain. *Recommended reading:* [1], section 8.1.

6	Partial derivatives of the first order. Differentiability of a function. Total differential of a function. Derivative of a function in a direction. Gradient of a function. Geometric meaning of the gradient. Tangent plane and normal to a surface. Geometric meaning of partial derivatives and differentials. *Recommended reading:* [1], sections 8.2, 8.4.
7	Derivative of a composite function. Derivative of an implicit function. Partial derivatives of higher orders. Differentials of higher orders *Recommended reading:* [1], sections 8.2, 8.4.
8	Extrema of functions of several variables. Necessary conditions for extrema. Sufficient conditions for extrema *Recommended reading:* [1], section 8.2
9	Conditional extremum. Lagrange multiplier method. Maximum and minimum values of a function in a domain. *Recommended reading:* [1], 8.5
10	Integral over a geometric object: concept of a geometric object and its measure, definition of an integral over a geometric object, properties and basic theorems. Double integral: definition of a double integral, basic properties and calculation in the Cartesian coordinate system (reduction to a single integral). A problem leading to the concept of a double integral. *Recommended reading:* [2], sections 10.1, 10.2.
11	Substitution of variables in a double integral. The concept of curvilinear coordinates on a plane, Jacobian transformation of coordinate systems (derivation of the Jacobian of the transition to polar and generalized polar coordinate systems). Theorem on substitution of variables in a double integral (without proof). Applications of double integrals. *Recommended reading:* [2], section 10.2.
12	Triple integral: definition of a triple integral, basic properties and calculation in the Cartesian coordinate system (reduction to repeated integrals). Substitution of variables in a triple integral, transition to cylindrical and spherical coordinate systems. Application of a triple integral. *Recommended reading:* [2], section 10.3.
13	Curvilinear integral of the first kind (by arc length): definition, basic properties, and methods of calculation. Theorem on the existence of a curvilinear integral of the first kind. Its geometric and physical applications. *Recommended reading:* [2], section 10.4.
14	Curvilinear integral of the second kind (by coordinates): vector and scalar notation of the integral, methods of calculation. Connection with the curvilinear integral of the first kind. Ostrogradsky-Green's theorem on the connection with the double integral. Theorem on the equivalence of 4 conditions. *Recommended reading:* [2], section 10.5.
15	Surface integral of the first kind (by surface area): definition, basic properties, and methods of calculation. *Recommended reading:* [2], sections 10.6.
16	Surface integral of the second kind (by coordinates): definition, basic properties, and methods of calculation. Formula for the connection with the integral of the first kind. Ostrogradsky-Gauss theorem on the connection with the triple integral. *Recommended reading:* [2], sections 10.6, 10.7.
17	Scalar and vector field: definitions, examples and their characteristics. Invariant definition of divergence. Vector notation of the Ostrogradsky-Gauss formula, application to the calculation of the flux of a vector field. *Recommended reading:* [2], sections 11.1.1–11.1.3.
18	Circulation of a vector field. Stokes' theorem on the connection between curvilinear and surface integrals of the second kind. Invariant definition of the rotor. Vector notation of Stokes' formula. *Recommended reading:* [2], sections 11.1.4, 11.2, 11.3.
19	Basic lessons of vector fields: solenoidal, potential, and harmonic. Their basic properties. First- and second-order vector differential operations. *Recommended reading:* [2], sections 11.2.

20	Ordinary differential equations (general information). First-order differential equations (DO): general form, concepts of general, partial, and particular solutions. Cauchy's problem for a first- order differential equation, its geometric and physical meaning. Cauchy's theorem. Examples of physical and geometric problems leading to DEs of the first order. *Recommended reading:* [1], sections 12.1.1-12.1.2.
21	Methods for solving first-order differential equations depending on their general form: differential equations with separable variables, homogeneous differential equations, and differential equations that can be reduced to homogeneous ones. The method of variation of an arbitrary constant (Lagrange's method) for solving first-order linear differential equations. Bernoulli's method for solving Bernoulli differential equations. *Recommended reading:* [1], sections 12.1.3 - 12.1.7.
22	Higher-order differential equations (general information). Cauchy's problem for higher-order differential equations, its geometric and physical meaning. Cauchy's theorem on sufficient conditions for the existence and uniqueness of the Cauchy problem (for second-order differential equations). Differential equations that allow for order reduction, methods for solving them. *Recommended reading:* [1], sections 12.2.1-12.2.2.
23	Linear differential equations of higher orders. Linearly dependent and linearly independent systems of functions. Wronski's determinant. Conditions for linear dependence and linear independence of systems of solutions to linear differential equations. *Recommended reading:* [1], sections 12.2.3. - 12.2.5.
24	Linear homogeneous differential equations of higher orders (LODEs). Properties of LODE solutions. Linear differential operator and its properties. Theorem on the structure of the general solution of LODEs. Linear homogeneous differential equations with constant coefficients. Euler's method for solving them. Construction of a fundamental system of solutions of LODEs depending on the type of roots of its characteristic equation. *Recommended reading:* [1], section 12.3.
25	Linear non-homogeneous differential equations of higher orders (LNDEs). Theorem on the structure of the general solution of LNDEs. Principle of superposition. Linear inhomogeneous differential equations with constant coefficients. Method of variation of arbitrary constants for their solution (Lagrange method). Demonstration of the method for solving second-order LNDEs. *Recommended reading:* [1], sections 12.4.1-12.4.2.
26	Linear inhomogeneous differential equations with constant coefficients and a special right-hand side. Method of selecting a partial solution of a linear inhomogeneous differential equation (depending on the form of the right-hand side of the differential equation). Solution scheme. *Recommended reading:* [1], sections 12.4.3 - 12.4.4.
27	Systems of differential equations (general information). Problems leading to systems of differential equations. Definition of a normal system. The concept of general and particular solutions of systems, solving Cauchy's problem. The connection between systems of differential equations and higher-order differential equations. Euler's method for solving homogeneous ODE systems with constant coefficients. Matrix method. *Recommended reading:* [1], section 12.5.

Practical lessons

The main objectives of the practical lessons cycle: to teach students to independently solve all types of mathematical problems that belong to the credit module "Higher Mathematics-3**".**

No No	Name of the topic and list of main questions (list of teaching aids, references to literature, and assignments for independent study)
1	KRSZ-1
2	Basic methods for calculating definite integrals. Independent study assignments: [2], Exercise 9.7.
3	Applications of definite integrals. Assignments for independent study: [2], Exercise 9.8.

4	Improper integrals of the first and second kind. Assignments for independent work: [2], Exercise 9.9.
5	Functions of several variables. Assignments for independent study: [1], Exercise 8.1.
6	Partial derivatives and differentials. Tangent plane and normal to the surface. Derivative in the direction. Gradient. Assignments for independent study: [1], Exercises 8.2-8.4.
7	Higher-order derivatives and differentials. Assignments for independent study: [1], Practical Work 8.2.
8	Extrema of functions of several variables. Conditional and global extrema. Assignments for independent work: [1], Exercise 8.5.
9	Conditional and global extrema. Assignments for independent work: [1], Exercise 8.5.
10	MODULE TEST – 1 "Definite integral. Differential calculus of functions of several variables variables."
11	Double integrals. Substitution of variables in a double integral. Applications. Assignments for SRC: [2], Practical Work 10.1.
12	Triple integrals. Substitution of variables in a triple integral. Applications. Assignments for independent work: [2], Exercise 10.2.
13	Curvilinear integrals of the first kind. Calculation. Application. Assignments for independent study: [2], Exercise 10.3.
14	Curvilinear integrals of the second kind. Calculations. Applications. Assignments for independent study: [2], Exercise 10.4.
15	Surface integrals of the first kind. Calculations. Applications.
	Assignments for independent work: [2], Exercise 10.5.
16	Surface integrals of the second kind. Calculations. Applications. Assignments for independent work: [2], Exercise 10.6.
17	Basic types of vector fields. Scalar field. Derivative in the direction. Gradient. Assignments for SRC: [2], Practical Work 11.1.
18	Vector field flux. Ostrogradsky-Gauss theorem. Rotor and circulation of a vector field. Stokes' theorem Assignments for independent work: [2], Exercise 11.2.
19	MODULE TEST – 2 "Integral calculus of functions of several variables."
20	Differential equations with separable variables. Homogeneous differential equations of the first order. Linear differential equations of the first order, Bernoulli's equation. Assignments for independent work: [2], Exercise 12.1.
21	Higher-order differential equations that allow for order reduction. Assignments for independent work: [2], Exercise 12.2.
22	Linear homogeneous differential equations of higher orders with constant coefficients. Assignment for independent work: [2], Exercise 12.3.
23	Linear non-homogeneous differential equations with constant coefficients and special right-hand side. Assignments for independent work: [2], Exercise 12.4.
24	Linear inhomogeneous equations with constant coefficients. Lagrange method. Assignment for independent work: [2], Exercise 12.4.
25	Systems of differential equations. Elimination method. Assignments for independent work: [2], Exercise 12.4.

26	Matrix method for solving linear homogeneous systems with constant coefficients. Assignments for independent work: [2], Practical Work 12.4.
27	MODULE TEST – 3 "Ordinary differential equations."

Independent work by the student

Independent work by students consists of studying lecture material, solving recommended problems on the relevant topic of practical lessons, and completing homework assignments. Submission of homework assignments precedes the writing of the Module test and is a prerequisite for admission to it.

Individual assignments

Individual assignments consist of homework assignments *on "Integral calculus of functions of one and many variables. Ordinary differential equations,"* part of which is written work, and part of which is in test format.

Homework assignments promote in-depth mastery of methods for solving typical mathematical problems that have practical significance. A collection of homework assignments is attached to this work program and is available in electronic form on the university's electronic campus. Methodological guidelines for completing the course work [ ] are available in electronic form on the university's electronic campus. The test part was developed using the Moodle platform and is available at the link on the department's website https://do.matan.kpi.ua/

Tests

One Module test is planned, which is divided into three tests from sections 1-4:

1. Module test -1. "Definite integral. Differential calculus of functions of several variables"
2. Module test -2. "Integral calculus of functions of several variables."
3. Module test -3. "Ordinary differential equations."

The purpose of the Module test s is to assess the level of mastery of the relevant modules and to calculate points according to the credit-modular system of modules.

Policy and control

2. Policy of the academic discipline (educational component)

Recommended learning methods: studying the main and supplementary literature on the topics of the lectures, solving problems in practical lessons and when doing homework.
Students are advised to take detailed lecture notes. An important aspect of effective learning, practicing methods and algorithms for solving basic problems in the discipline is independent work. It includes reading literature, reviewing literature on the topic, preparing for lessons, completing homework assignments, preparing for midterm and final exams.

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." For more information, see: https://kpi.ua/code

Standards of ethical behavior

The standards of ethical conduct for 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." For more information, please visit: https://kpi.ua/code

3. Types of control and rating system for assessing learning outcomes (RSA) (full-time/distance learning)

Distribution of study time by type of lesson and assignment in accordance with the working curriculum.

Semester	Study time		Distribution of teaching hours				Control measures		
	Credits	academic hours	Lectures	Practical	Lab work	SRS + Ex.	MODULE TEST	DCR	Semester assessment
1	7	210	54	54	-	102	1	1	copies

A student's grade for a course consists of points awarded for

1) answers in practical lessons;
2) one test (the Module test can be divided into several tests);
3) one HCW
4) answer on the exam.

The size of the rating scale *R* = 100 points. The size of the starting scale $_{RC}$ = 50 points. The size of the exam scale $_{RE}$ = 50 points.

Rating (weighting) point system and assessment criteria

1. Work in practical lessons

Weighted score –15. The maximum number of points for all practical lessons is 15 points.

0.0 – refusal to answer, lack of knowledge of the necessary theoretical material;

0.25 – knowledge of individual fragments of theoretical material, ability to apply some of them;.

0.5 – superficial knowledge of theoretical material, solving a problem with the help of a teacher;

0.75 – good knowledge of theoretical material, ability to apply it;

1 – perfect knowledge of theoretical material, almost independent problem solving. Each completed homework assignment is graded at 0.5 points.

2. Module test

Weighting score -20. The maximum number of points for all tests is 20 points Module test assessment criteria: absence from the test – 0 points,

the Module test grade (in points) is equal to the percentage (of the maximum number of points, 20) of its completion. If < 60% is completed, the test is not counted.

3. Home Control Work (HCW).

Weighted score – 15. HCW assessment criteria:

Failure to complete the HCW – 0 points. The HCW is completed and defended in parts that correspond in content to the modular control work. This part of the HCW is submitted before writing the MODULE TEST , and the MODULE TEST itself is its defense.

The HCW grade (in points) is equal to the percentage (of the maximum number of points, 15) of its completion, taking into account the result of writing the corresponding taking into account the result of writing the corresponding. If less than 60% of the HCW is completed, it is not counted. For late submission (more than a week late) of the DCR, no more than 60% is counted.

4. Exam answer Weighted score – 50.

The number of rating exam points is equal to the percentage (of the maximum score of 50) of the exam work completed. If less than 60% (<30 points) of the exam work is completed, it is not and must be rewritten.

Bonus points are awarded for successful performance in the mathematics Olympiad (maximum 5 points per semester).

Conditions for a positive interim assessment.

To receive a "pass" on the first interim assessment (week 8), students must have at least 50% of the planned number of points. To receive a "pass" on the second interim assessment (week 14), the student must also have at least 50% of the planned number of points.

If a student is unable to write a Module test for valid reasons, they are given the opportunity to rewrite it within the next two weeks.

Retaking a positive final semester assessment in order to improve the grade is not permitted.

A student is admitted to the exam if his semester rating is not less than 30 points, while he has at least one positive assessment, credited modular control works and a typical calculation (completed not less than 60%). If the semester rating is less than 30 points but greater than 20, the student may write an admission test test. If it is written successfully (at least 60% of the problems are solved correctly), the semester rating will be 30 points.

Table for converting the rating assessment for the academic discipline R: *(according to Table 1)*

$R = R_I + R_E$	**ECTS grade**	**Traditional grade**
95	A	Excellent
85	In	Very good
75...84	C	Good
65...74	D	satisfactory
60...64	E	sufficient
$R \le 60$	Fx	unsatisfactory
$R_I < 30$ or other conditions for admission to the exam	F	not admitted

4. Additional information on the discipline (educational component)

During the legal regime of martial law, the educational process at Igor Sikorsky KPI for full-time and part-time higher education students is conducted remotely. In the case of distance learning, the educational process is organized using e-mail, Telegram, video conferences in Zoom, and the Moodle educational platform. Current control can be carried out in the form of test control works in Moodle. The RS may also be changed in accordance with the order of the KPI and the decision of the department.

Work program for the academic discipline (syllabus): Compiled by:

Associate Professor of the Department of Mathematics and Physics, Candidate of Physical and Mathematical Sciences, Associate Professor O.O. Dykhovychnyi.

Approved by the MA and TY Department (Minutes No. 13 dated June 11, 2024).

Approved by the Methodological Council of the RTF (Minutes No. 6 dated 28.06.2024).