MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
THE NATIONAL TECHNICAL UNIVERSITY OF UKRAINE
“Igor Sikorsky Kyiv Polytechnic Institute”
FACULTY OF PHYSICS AND MATHEMATICS

APPROVED BY
Dean of the Faculty of
Physics and Mathematics
_____ Volodymyr Vanin
«____»_____ 2020

HIGHER MATHEMATICS 2.
Differential and Integral Calculus of the Function of Several Variables. Differential Equations.

SYLLABUS OF THE CREDIT MODULE

The first bachelor level of higher education

Specialty 131 "Applied Mechanics"

Profile program Manufacturing Engineering

Full-time form of study

Approved by the methodical commission of
the Faculty of Physics and Mathematics
Protocol dated _____ 2020 № ___
Head of the methodical commission
_____ (Nadiia Reva)
«____»_____ 2020.

Kyiv – 2020

Syllabus of the Credit Module "Higher Mathematics 2. Differential and Integral Calculus of the Function of Several Variables. Differential Equations" is based on the Curriculum "Higher Mathematics".

DEVELOPER OF THE SYLLABUS OF THE CREDIT MODULE:

Associate Professor, PhD Ganna Zhuravska _____

The Syllabus of the Credit Module is approved at the meeting of the department of Mathematical Physics of the Faculty of Physics and Mathematics of “Igor Sikorsky Kyiv Polytechnic Institute”

Protocol dated _____2020 № ___

Head of the Department _____Volodymyr Gorbachuk

«____» _____2020.

1. Description of the Credit Module

<table>
<tr><td>Level of HE,
Specialty
Profile Programs
Form of Study</td><td>General Indicators</td><td>Credit Module's Characteristics</td></tr>
<tr><td>Level of HE
The first bachelor</td><td>Name of the discipline to which the credit module belongs
Higher mathematics</td><td>Lectures
72 hours</td></tr>
<tr><td>Specialty
131 "Applied Mechanics"</td><td>Cycle to which the credit module belongs
General training</td><td>Practical Lessons
72 hours</td></tr>
<tr><td rowspan="2">Profile Programs
Manufacturing Engineering</td><td>The status of the discipline
Compulsory.</td><td>Self-study work
111 hours
Including the implementation of individual tasks
10 hours</td></tr>
<tr><td>Semester
Second</td><td>Individual home work
Individual tasks</td></tr>
<tr><td>Form of Study
Full-time</td><td>Number of Credits (Hours)
8,5 (255)</td><td>Type and form of the semester's control:
Oral exam</td></tr>
</table>

The credit module belongs to the discipline "Higher Mathematics" and is included in the cycle of natural-scientific trainings for bachelors of the specialty 131 "Applied Mechanics". This credit module has a close relationship with credit modules: "Higher Mathematics 1: Differential and integral calculus of a function of one variable" and "Higher Mathematics 3: Series. Theory of the Functions of a Complex Variable" of this discipline. Also it is used in other credit modules, which are included in the disciplines according to the curriculum for the specialty" Applied Mechanics ".

2. Learning Objectives and Tasks of Credit Module

The purpose of the credit module is to form students' abilities:

- acquiring the basic concepts and methods of the integral calculus of the function of one variable, differential and integral calculus of the function of several variables, differential equations;
- using methods of mathematics in engineering calculations;
- analyzing the results obtained;
- independently using and studying literature on mathematics.

According to the requirements of the syllabus students must demonstrate the following learning outcomes:

Knowledge:

- the bases of the integral calculus of functions of one and many variables (indefinite integral, properties of an indefinite integral, a table of integrals, methods of integration);
- the bases of the integral calculus of functions of several variables (definite integral and its geometric interpretation, fundamental theorem of calculus, improper integrals, double and triple integrals, methods of calculation in different coordinate systems, line and surface integrals, application of all kinds of integrals to problems of geometry and physics, vector calculus);
- the fundamentals of the theory and practice of ordinary differential equations (differential equations of the first order, separable, homogeneous and Bernoulli differential equations, the initial value problem, differential equations of higher orders, linear constant coefficients homogeneous and non homogeneous differential equations of higher orders, reduction of order).

Skills:

- to find indefinite integrals by basic methods of integration;
- to find indefinite integrals of rational, fractional-rational, trigonometric, irrational functions by basic methods of integration;
- to calculate of definite integrals, to apply integrals;
- to find partial derivatives and differentials for a function of several variables; to apply partial derivatives; to find extrema of a function of two variables; to find the gradient and directional derivative of a scalar field;
- double, triple, line and surface integrals in different systems of coordinates, to apply all kinds of integrals;
- to find general and partial solutions of differential equations; to find general and partial solutions of systems of linear constant coefficients equations.

3. The Structure of the Credit Module

Parts and Topics	Number of Hours			
	Total	Including		
		Lectures	Practical Training	Self-study
1	2	3	4	5
Part 3. Integral Calculus of Functions of one variable.				
Topic 3.3. Integration of Rational, Irrational and Trigonometric Functions.	29	10	10	9
Topic 3.4. The Definite Integral. Properties of the Definite Integral. Fundamental Theorem of Calculus (Newton-Leibniz Formula). Techniques of Evaluating Definite Integrals (Integration by Parts; Integration by Substitution). Improper Integrals.	18	6	6	6
Topic 3.5. Application of the Definite Integral. The Area of a region. The Volume of a Solid of Revolution. The Arc length. The Surface of a Solid of Revolution.	12	4	4	4
Test 1	4		2	2
Total for Part 3	**63**	**20**	**22**	**21**
Part 4. Differential Calculus of Functions of Several Variables.				
Topic 4.1. The Concept of a Function of Several Variables. Limit and Continuity of a Function of Several Variables.	2	1		1
Topic 4.2. Partial Derivatives of a Function of Several Variables. Partial Derivatives of Higher Orders. The Partial Derivatives of a Composite Function.	4	1	2	1
Topic 4.3 Differentials of a Function of Several Variables and Their Properties. The Partial Derivatives of an Implicit Function.	5	2	2	1

Topic 4.4. The Tangent Plane and the Normal Line to a Surface. Taylor's Formula for the Function of Two Variables. Local Extrema of a Function of Two Variables. The Largest and Smallest Value of a Function of Two Variables in the Region.	10	4	3	3
Test 2	3		1	2
Total for Part 4	**24**	**8**	**8**	**8**
Part 5. Multiple Integrals.				
Topic 5.1. The Concept of a Double Integral. Properties. Calculating Double Integral in Cartesian Coordinates.	6	2	2	2
Topic 5.2. Changing Variables in a Double Integral. Double Integral in Polar Coordinates. Application of a Double Integral to Problems of Geometry and Mechanics.	10	2	4	4
Topic 5.3. The Concept of a Triple Integral. Properties. Calculating Triple Integral in Cartesian Coordinates.	6	2	2	2
Topic 5.4. Changing Variables in a Triple Integral. Calculating Triple Integral in Cylindrical and Spherical Coordinates. Application of the Triple Integral to Problems of Geometry and Mechanics.	7	2	3	2
Test 3	3		1	2
Total for Part 5	**32**	**8**	**12**	**12**
Part 6. Line Integrals.				
Topic 6.1. The Concept of Line Integrals with Respect to Arc Length. Properties, Calculating and Application.	4	2	1	1

Topic 6.2. The Concept of Line Integrals of Vector Fields. Properties, Calculating and Application.	4	2	1	1
Topic 6.3. Green's formula. Independence of Path.	6	2	2	2
Total for Part 6	**14**	**6**	**4**	**4**
Part 7. Surface Integrals.				
Topic 7.1. The Concept of Surface Integrals. Properties. Oriented Surfaces.	4	2	1	1
Topic 7.2. Calculating Surface Integrals. Application.	4	2	1	1
Topic 7.3. Ostrogradsky's Formula. Stokes' formula.	6	2	2	2
Total for Part 7	**14**	**6**	**4**	**4**
Part 8. Vector calculus.				
Topic 8.1. Basic Concepts of Vector calculus. Scalar Field and Its Properties. Gradient. Directional Derivative.	5	2	2	1
Topic 8.2. Vector field. Flux of a Vector Field. Divergence. Divergence Theorem.	6	2	2	2
Topic 8.3. Circulation around the closed curve. Curl.	4	2	1	1
Topic 8.4. The Hamiltonian Operator and Certain Applications of It.	2	2		
Test 4	3		1	2
Total for Part 8	**20**	**8**	**6**	**6**
Part 9. First-Order Differential Equations.				
Topic 9.1. Basic Concepts and Definitions. The Initial Value Problem. Differential Equations with Separable Variables. Homogeneous Differential Equations. Exact Differential Equations.	6	2	2	2
Topic 9.2. First-Order Linear Differential	6	2	2	2

Equations. Bernoulli's equation.				
Total for Part 9	**12**	**4**	**4**	**4**
Part 10. Higher-Order Differential Equations.				
Topic 10.1. Basic Concepts and Definitions. Some Types of Second-Order Differential Equations Reducible to First-Order Equations.	6	2	2	2
Topic 10.2. Second-Order Homogeneous Linear Differential Equations. Functions that Are Linearly Independent on an Interval. Wronskian. Fundamental System of Solutions.	3	2	2	1
Topic 10.3. Second-Order Homogeneous Linear Differential Equations with Constant Coefficients. Characteristic Equation. General solution.	5	2	2	1
Topic 10.4. Second-Order Nonhomogeneous Linear Differential Equations. The Method of Variation of Arbitrary Constants.	6	2	2	2
Topic 10.5. Second-Order Nonhomogeneous Linear Differential Equations with Constant Coefficients and Special Right-Hand Side.	6	2	2	2
Topic 10.6. Systems of Differential Equations: Basic Concepts and Definitions. Systems of Linear Differential Equations with Constant Coefficients.	6	2		2
Test 5	4		2	2
Total for Part 10	**36**	**12**	**12**	**12**
Individual Tasks	10			10
Preparation to the Exam	30			30
Total	**255**	**72**	**72**	**111**

4. Lectures

№	The title of the lecture and a list of the main subtopics (task for the self-study and readings)
1-2	Integration of Rational Functions. Task for the Self-study: learn the lecture. Readings: [1] Chapter X §5,7-9.
3-4	Integration of Irrational Functions. Task for the Self-study: learn the lecture. Readings: [1] Chapter X §11-13.
5	Integration of Trigonometric Functions. Task for the Self-study: learn the lecture. Readings: [1] Chapter X §14-15.
6	The Definite Integral. Properties of the Definite Integral. Task for the Self-study: learn the lecture. Readings: [1] Chapter XI §1-3, [2] Chapter 4 §4.1,4.5
7	Fundamental Theorem of Calculus (Newton-Leibniz Formula). Techniques of Evaluating Definite Integrals (Integration by Parts; Integration by Substitution). Task for the Self-study: learn the lecture. Readings: [1] Chapter XI §4-6, [2] Chapter 4 §4.2.
8	Improper Integrals. Task for the Self-study: learn the lecture. Readings: [1] Chapter XI §7, [2] Chapter 6 §6.7.
9-10	Application of the Definite Integral. The Area of a region. The Volume of a Solid of Revolution. The Arc length. The Surface of a Solid of Revolution. Task for the Self-study: learn the lecture. Readings: [1] Chapter XII §1-8, [2] Chapter 6 §6.2-6.4.
11	The Concept of a Function of Several Variables. Limit and Continuity of a Function of Several Variables. Partial Derivatives of a Function of Several Variables. Partial Derivatives of Higher Orders. Task for the Self-study: learn the lecture. Readings: [1] Chapter VIII §1-5, [2] Chapter 11 §11.1-11.3.
12	Differentials of a Function of Several Variables and Their Properties. The Partial Derivatives of an Implicit Function. The Partial Derivatives of a Composite Function. Task for the Self-study: learn the lecture. Readings: [1] Chapter VIII §7,10-12, [2] Chapter 11 §.11.5,11.6,11.8
13	The Tangent Plane and the Normal Line to a Surface. Taylor's Formula for the Function of Two Variables. Task for the Self-study: learn the lecture. Readings: [1] Chapter VIII §16, Chapter IX §6, [2] Chapter 11 §11.4.

14	Local Extrema of a Function of Two Variables. The Largest and Smallest Value of a Function of Two Variables in the Region. Task for the Self-study: learn the lecture. Readings: [1] Chapter VIII §17,18, [2] Chapter 11 §11.7.
15	The Concept of a Double Integral. Properties. Calculating Double Integral in Cartesian Coordinates. Task for the Self-study: learn the lecture. Readings: [1] Chapter XIV §1-4, [2] Chapter 12 §12.1-,12.3.
16	Changing Variables in a Double Integral. Double Integral in Polar Coordinates. Application of a Double Integral to Problems of Geometry and Mechanics. Task for the Self-study: learn the lecture. Readings: [1] Chapter XIV §5-10, [2] Chapter 12 §12.4-12.5.
17	The Concept of a Triple Integral. Properties. Calculating Triple Integral in Cartesian Coordinates. Task for the Self-study: learn the lecture. Readings: [1] Chapter XIV §11,12, [2] Chapter 12 §12.6.
18	Changing Variables in a Triple Integral. Calculating Triple Integral in Cylindrical and Spherical Coordinates. Application of the Triple Integral to Problems of Geometry and Mechanics. Task for the Self-study: learn the lecture. Readings: [1] Chapter XIV §13,14, [2] Chapter 12 §12.7.
19	The Concept of Line Integrals with Respect to Arc Length. Properties, Calculating and Application. Task for the Self-study: learn the lecture. Readings: [1] Chapter XV §1, [2] Chapter 13 §13.2.
20	The Concept of Line Integrals of Vector Fields. Properties, Calculating and Application. Task for the Self-study: learn the lecture. Readings: [1] Chapter XV §2, [2] Chapter 13 §13.2.
21	Green's formula. Independence of Path. Task for the Self-study: to learn the lecture. Readings: [1] Chapter XV §3,4, [2] Chapter 13 §13.3,13.4.
22	The Concept of Surface Integrals. Properties. Oriented Surfaces. Task for the Self-study: learn the lecture. Readings: [1] Chapter XV §5, [2] Chapter 13 §13.5.
23	Calculating Surface Integrals. Application. Task for the Self-study: learn the lecture. Readings: [1] Chapter XV §6, [2] Chapter 13 §13.5.
24	Ostrogradsky’s Formula. Stokes’ formula. Task for the Self-study: learn the lecture. Readings: [1] Chapter XV §7,8, [2] Chapter 13 §13.5.

25	Basic Concepts of Vector calculus. Scalar Field and Its Properties. Gradient. Directional Derivative. Task for the Self-study: learn the lecture. Readings: [1] Chapter VIII §2,13-15, [2] Chapter 13 §13.1.
26	Vector field. Flux of a Vector Field. Divergence. Divergence Theorem. Task for the Self-study: learn the lecture. Readings: [1] Chapter XV §9.
27	Circulation around the closed curve. Curl. Task for the Self-study: learn the lecture. Readings: [1] Chapter XV §9.
28	The Hamiltonian Operator and Certain Applications of It. Task for the Self-study: learn the lecture. Readings: [1] Chapter XV §9.
29	Basic Concepts and Definitions. The Initial Value Problem. Differential Equations with Separable Variables. Homogeneous Differential Equations. Exact Differential Equations. Task for the Self-study: learn the lecture. Readings: [1] Chapter XIII §1-6,9, [2] Chapter 14 §14.1,14.2.
30	First-Order Linear Differential Equations. Bernoulli's equation. Task for the Self-study: learn the lecture. Readings: [1] Chapter XIII §7,8, [2] Chapter 14 § 14.3.
31	Basic Concepts and Definitions. Some Types of Second-Order Differential Equations Reducible to First-Order Equations. Task for the Self-study: learn the lecture. Readings: [1] Chapter XIII §16-18.
32	Second-Order Homogeneous Linear Differential Equations. Functions that Are Linearly Independent on an Interval. Wronskian. Fundamental System of Solutions. Task for the Self-study: learn the lecture. Readings: [1] Chapter XIII §20.
33	Second-Order Homogeneous Linear Differential Equations with Constant Coefficients. Characteristic Equation. General solution. Task for the Self-study: learn the lecture. Readings: [1] Chapter XIII §20, [2] Chapter 14 § 14.6.
34	Second-Order Nonhomogeneous Linear Differential Equations. The Method of Variation of Arbitrary Constants. Task for the Self-study: learn the lecture. Readings: [1] Chapter XIII §21,22.
35	Second-Order Nonhomogeneous Linear Differential Equations with Constant Coefficients and Special Right-Hand Side. Task for the Self-study: learn the lecture. Readings: [1] Chapter XIII §23,24.

36	Systems of Differential Equations: Basic Concepts and Definitions. Systems of Linear Differential Equations with Constant Coefficients. Task for the Self-study: learn the lecture. Readings: [1] Chapter XIII §29,30.

5. Practical Trainings

№	The title of the practical training and a list of the main subtopics (task for the self-study and readings)
1-2	Integration of Rational Functions. Task for the Self-study: solve a homework assignment.
3-4	Integration of Irrational Functions. Task for the Self-study: solve a homework assignment.
5	Integration of Trigonometric Functions. Task for the Self-study: solve a homework assignment.
6	The Definite Integral. Fundamental Theorem of Calculus (Newton-Leibniz Formula). Techniques of Evaluating Definite Integrals. Task for the Self-study: solve a homework assignment.
7-8	Improper Integrals. Task for the Self-study: solve a homework assignment.
9	Application of the Definite Integral. The Area of a region. Task for the Self-study: solve a homework assignment.
10	The Volume of a Solid of Revolution. The Arc length. The Surface of a Solid of Revolution. Task for the Self-study: solve a homework assignment.
11	Test 1.
12	The Concept of a Function of Several Variables. Limit and Continuity of a Function of Several Variables. Partial Derivatives of a Function of Several Variables. Task for the Self-study: solve a homework assignment.
13	Partial Derivatives of Higher Orders. The Partial Derivatives of a Composite Function. Task for the Self-study: solve a homework assignment.
14	Differentials of a Function of Several Variables. The Tangent Plane and the Normal Line to a Surface. Taylor's Formula for the Function of Two Variables. Task for the Self-study: solve a homework assignment.
15	Local Extrema of a Function of Two Variables. The Largest and Smallest Value of a Function of Two Variables in the Region. (1 hour) Task for the Self-study: solve a homework assignment. Test 2. (1 hour)

16	Double Integral. Calculating Double Integral in Cartesian Coordinates. Task for the Self-study: solve a homework assignment.
17	Changing Variables in a Double Integral. Double Integral in Polar Coordinates. Task for the Self-study: solve a homework assignment.
18	Application of a Double Integral to Problems of Geometry and Mechanics. Task for the Self-study: solve a homework assignment.
19	Triple Integral. Calculating Triple Integral in Cartesian Coordinates. Task for the Self-study: solve a homework assignment.
20	Changing Variables in a Triple Integral. Calculating Triple Integral in Cylindrical and Spherical Coordinates. Task for the Self-study: solve a homework assignment.
21	Application of the Triple Integral to Problems of Geometry and Mechanics. (1 hour) Task for the Self-study: solve a homework assignment. Test 3. (1 hour)
22	Line Integrals. Calculating and Application. Task for the Self-study: solve a homework assignment.
23	Green's formula. Independence of Path. Task for the Self-study: solve a homework assignment.
24	Surface Integrals. Calculating and Application. Task for the Self-study: solve a homework assignment.
25	Ostrogradsky's Formula. Stokes' formula. Task for the Self-study: solve a homework assignment.
26	Basic Concepts of Vector calculus. Scalar Field and Its Properties. Gradient. Directional Derivative. Task for the Self-study: solve a homework assignment.
27	Vector field. Flux of a Vector Field. Divergence. Divergence Theorem. Curl. Task for the Self-study: solve a homework assignment.
28	Circulation around the closed curve. (1 hour) Task for the Self-study: solve a homework assignment. Test 4. (1 hour)
29	Differential Equations with Separable Variables. Homogeneous Differential Equations. The Initial Value Problem. Task for the Self-study: solve a homework assignment.
30	First-Order Linear Differential Equations. Bernoulli's equation Task for the Self-study: solve a homework assignment.
31	Second-Order Differential Equations Reducible to First-Order Equations. Task for the Self-study: solve a homework assignment.

32	Second-Order Homogeneous Linear Differential Equations. Functions that Are Linearly Independent on an Interval. Wronskian. Fundamental System of Solutions. Second-Order Homogeneous Linear Differential Equations with Constant Coefficients. Characteristic Equation. General solution. Task for the Self-study: solve a homework assignment.
33	Second-Order Nonhomogeneous Linear Differential Equations with Constant Coefficients and Special Right-Hand Side. Task for the Self-study: solve a homework assignment.
34	Second-Order Nonhomogeneous Linear Differential Equations. The Method of Variation of Arbitrary Constants. Task for the Self-study: solve a homework assignment.
35	Systems of Linear Differential Equations with Constant Coefficients. Task for the Self-study: solve a homework assignment.
36	Test 5.

6. Individual tasks

It is planned one set of individual tasks to the topics of parts 3-10 in the second semester.

They are aimed at broadening and deepening theoretical knowledge of students and promoting independent solving of specific problems.

7. Tests

According to the Syllabus of the discipline "Higher Mathematics" there is one modular test planned. This modular test consist of five tests. Tests are designed to execute ongoing control and assessment of student’s knowledge by the teacher.

Examples of tests are provided to the Curriculum of the Credit Module in the form of an appendix 1.

8. Assessment of learning outcomes

The rating system is provided to the Curriculum of the Credit Module in the form of an appendix 2.

9. Learning Activities and Teaching Methods

Basic teaching methods:

1. Solving examples and tasks during practical trainings through active and collective learning, part-search and research methods;
2. As an addition to traditional training activities there are proposed such activities as Internet mailing, Distance and online learning, online testing ect.

10. Readings

1. N.Piscunov Differential and Integral Calculus/ N.Piscunov – Mir Publisher, Moscow, 1966 – 895 p.

2. H. Jerome Keisler Elementary Calculus: an Infinitesimal Approach/ H. Jerome Keisler – On-line Edition. 2000
https://www.math.wisc.edu/~keisler/calc.html

3. Jeffrey R. Chasnov Introduction to Differential Equations. Lecture notes for MATH 2351/2352 / Jeffrey R. Chasnov – The Hong Kong University of Science and Technology, 2016 – 147p.
http://www.math.ust.hk/~machas/differential-equations.pdf

10. Informational Support

1. http://tutorial.math.lamar.edu
2. https://www.khanacademy.org
3. https://www.vitutor.com

Appendix 1.

Test 1.

1. Find the indefinite integrals.

1.1 $\int \cos^4 12x dx$; 1.2 $\int \frac{3x-4}{\sqrt{x^2+8x+3}} dx$; 1.3 $\int \frac{\sqrt{\ln^3 x}}{x} dx$;

1.4 $\int \frac{1}{(x+3)(x-4)^2} dx$; 1.5 $\int \cos^4 x \sin^5 x dx$; 1.6 $\int 4^x \sin 4^x dx$.

2. Calculate the definite integrals 2.1 $\int_0^1 (8-3x)2^{2x} dx$; 2.2 $\int_0^{0,5} \frac{2x}{\sqrt{1-(x^2)^2}} dx$.

3. Determine whether the improper integral converges or diverges $\int_0^{\infty} \frac{1}{\sqrt[3]{x+2}} dx$.

4. Find the area of the region bounded by $y = x^2 - 4x + 5$ and $y = 6 - x^2$.

Test 2.

1. Find partial derivatives $\frac{\partial z}{\partial x}, \frac{\partial z}{\partial y}, \frac{\partial^2 z}{\partial x^2}, \frac{\partial^2 z}{\partial x \partial y}, \frac{\partial^2 z}{\partial y^2}, \frac{\partial^2 z}{\partial y \partial x}$ and differentials dz, $d^2 z$: $z = \cos(x+2y) + x^6 y^{-8} + y + 9$.

2. Find local extrema of function $z = (x-5)^2 + y^2 + 1$.

Test 3.

1. Determine the area of region $D: x = 1, y = 2 + x^2, y = -\sqrt{x}$, $x \geq 0$ using double integral.

2. Use a triple integral to determine the mass of the region $x + 9y + 6z = 18$, $x \geq 0$, $y \geq 0$, $z \geq 0$ if the function of Linear density is $\mu = 4x - 5y$.

3. Use a triple integral to determine the volume of the region $z = \sqrt{64 - x^2 - y^2}$, $12z = x^2 + y^2$.

Test 4.

1. Compute $\operatorname{div}\vec{F}$ and $\operatorname{curl}\vec{F}$ if $\vec{F}(x,y,z)=\operatorname{grad}u,\ u=\dfrac{y^3}{x^2z}$.

2. Evaluate the Flux of vector field $\vec{F}(M)=(x+2z)\vec{i}+(y-3z)\vec{j}+z\vec{k}$ which passes through a surface $3x+2y+2z=6,\ x>0, y>0, z>0.$ **(oriented outwards)**

3. Evaluate the Flux of vector field $F=2xi+yj-2zk$ which passes through the closed surface $z=3-2(x^2+y^2), z^2=x^2+y^2 (z\geq 0).$ **(oriented outwards)**

4. Evaluate the Circulation of vector field $\vec{F}(M)=(x+y+z)\vec{i}+2z\vec{j}+(y-7z)\vec{k}$ around the contour formed by intersection of a plane $2x+3y+z=6$ and cylinder $x^2+y^2=36$, with a positive direction.

Test 5.

Solve differential equations

1. $y(1+\ln y)+xy'=0.$
2. $y'=\dfrac{y^2}{x^2}+6\dfrac{y}{x}+6.$
3. $y'+\dfrac{y}{2x}=x^2, y(1)=1.$
4. $y^3y''+25=0.$
5. $y''-6y'+8y=8x^2+\cos x.$

Appendix 2.

The Rating System

1. The student rating of the credit module is calculated from 100 points, 60 of them are the starting scores. Starting scores (during the semester) consists of the points that the student receives for:

1) responses during practical lessons (36 lessons);
2) five thematic tests;
3) individual tasks.

2. Criteria for scoring points

2.1. Responses during practical lessons:

- student has a thorough knowledge and understanding of the content and a high level of competence in the processes and skills - 1 point;
- student has achieved a basic level of competence in the processes and skills - 0.5 points;
- student has no elementary knowledge and understanding of the content - 0 points.

2.2. Thematic test

- complete solutions (no less than 90% of the required information) - 6 points;
- solutions with minor inaccuracies (no less than 75% of the required information) -4-5 points;
- mistakes in an solutions (no less than 50% of the required information) - 2-3 points;
- no solutions - 0 points.

2.3. Individual tasks — 14 балів.

- complete solutions - 14 points;
- solutions with minor inaccuracies - 10-13 points;
- mistakes in an solutions - 7-9 points;
- no solutions - 0 points.

Each week of delay of the submission of the individual tasks to examination are provided with penalty (-5) points.

3. The requirement to the first attestation is to receive at least 11 points. The requirement to the second attestation is to receive at least 18 points.

4. The allowance requirement to passing the exam is the individual tasks, that must be credited, and no less than 36 points of starting score.

5. At the exam each student have two theoretical questions (8 points each) and three practical ones (8 points each). Total exam score is 40 points.

The criterion for evaluating theoretical questions:

- full answer (not less than 90% of the required information) - 8 points.
- sufficiently complete answer (not less than 75% of the required information, or minor inaccuracies) - 6-7 points.
- incomplete answer (not less than 60% of the required information and some mistakes) - 4-5 points.
- wrong answer - 0 points.

Criteria for evaluating practical tasks:

- complete solution of the task - 8 points.
- solution of the task with minor inaccuracies - 6-7 points.
- the task is solved with some mistakes - 4-5 points.
- the task is not solved - 0 points.

If the exam score is less than 24 points, then the student gets an "unsatisfactory" rating.

6. The sum of the starting score and the exam score (personal score) is transferred into the grade of credit module according to the table:

PERSONAL SCORE	**GRADE**
95-100	Excellent
85-94	Very Good
75-84	Good
65-74	Satisfactory
60-64	Sufficiently
Personal score<60 or the exam score is less than 24 points	Unsatisfactory
Personal score < 36 or the individual tasks is not credited	Not allowed to pass exam