MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY
Faculty of Transport, Management and Logistics
Department of Higher mathematics

AGREED
Dean of Aerospace Faculty

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«___»_____2021

Quality Management System
COURSE TRAINING PROGRAM
on
«Higher Mathematics»

Educational Professional program: «Aircraft Equipment»

Field of study: 13 «Mechanical engineering»
Speciality: 134 «Aviation and Space Rocket Techniques»

Training Form	Semes-ter	Total (hours/ credits ECTS)	Lectu-res	Practi-cals	Lab. clas.	Self-study	HW/ CSP	TP/CP	Semester Grade
Full-time	1,2,3,4	585/19,5	119	170	–	296	HW-1s.,2s.,3s., 4s.	–	examination 1s.,4s. graded test 2s.,3s.

Indexes: CB-1-134-2/21-2.1.1

Course Training Program on «Higher Mathematics» is developed on the basis of the Educational Program on “Airplanes and Helicopters”, “Aircraft Equipment” Bachelor Curriculum and Extended Curriculum №СВ-1-134-2/21, №ЕСВ-1-134-2/21 for Speciality 134 «Aviation and Space Rocket Technology» and corresponding normative documents.

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Contents

INTRODUCTION

The Course Training Program of the subject "Higher mathematics" is developed on the basis of the "Methodical guidance for the development of a course training program of the subject", approved by the order № 249/од. dated 29.04.2021 p. correspondent normative documents.

1. EXPLANATORY NOTE

1.1 Place, objectives, tasks of the subject

Place: This subject is considered as a theoretical and practical basis of knowledge and skills that form the expert's profile in the field of transport technologies and rocket and space technology.

The subject **target** is to teach students to master the appropriate mathematical apparatus, which should be sufficient to develop mathematical models related to the further practical activities of specialists.

Objectives of the subject are:

- development of analytical, logical, creative and algorithmic thinking of students;
- mastering the necessary theoretical knowledge and the main directions of their application in the system of disciplines in the specialty;
- instilling primary skills in mathematical research of applied problems;
- developing the ability to independently use the necessary methods and literature in solving problems

1.2. Learning outcomes the subject makes it possible to achieve

As a result of this subject mastering a student should acquire such **learning outcomes**:

- apply the theory of higher mathematics to solve problems of aeronautical and rocket and space engineering;
- use mathematical knowledge to describe, calculate and model functional and liquid-gas systems of aviation and rocket and space technology;
- find, analyze, evaluate and use information from different sources, as well as classify the properties or common features of the elements, explain and justify information on ways to improve the efficiency and quality of functional and liquefied gas systems in their modeling and parameters of aviation in general ;
- knowledge and understanding of the principles of fundamental mathematical methods of modeling and optimization, to look for the most rational variations and make a scientifically sound choice of the optimal option for modeling functional and liquefied gas systems or study the parameters of aviation in general;
- systematically think and apply creative abilities to the formation of fundamentally new ideas;
- to carry out analytical research of parameters of functioning of aviation equipment and the analysis of the chosen methods and means of their automated designing;
- have the skills to experiment and analyze the results of the study.

1.3. Competences the subject makes it possible to acquire

As a result of this subject mastering a student should acquire such **competencies**:

- ability to learn and master modern knowledge;
- ability to operate with modern methods of higher mathematics and realize the importance of mathematics as a universal language of science, technology and engineering;
- the ability to visualize mathematical models, depict figures, graphs, drawings, diagrams, charts;
- ability to study the simplest mathematical models of real objects, processes and phenomena related to the development and production of aviation and rocket and space technology;
- ability to apply and improve existing quantitative mathematical, scientific and technical methods, as well as computer software for solving engineering problems in the design of aircraft and equipment;

- ability to build, interpret and evaluate results; to forecast in the context of educational and practical specialized tasks;

- ability to apply a systematic approach to solving engineering problems in the design of aircraft and its equipment;

- ability to determine the adequacy of data in solving specialized problems; find information and assess its reliability; be able to prove the truth of statements and prove the correctness of their own judgment or admit their falsity;

- ability to generate new ideas (creativity), analyze and make optimal decisions; use criteria of practicality, efficiency and accuracy to choose the best solution;

- ability to improve their skills based on the analysis of previous experience;

- ability to argue and defend their position, use different strategies, make informed decisions.

1.4. Interdisciplinary connections

The subject "Higher Mathematics" is basic for the study such subjects as: "Theoretical mechanics", "Hydropneumatic devices of aircraft", "Functional and liquid-gas systems of aircraft", "Design and strength of aircraft", "Hydraulics" and others.

2. COURSE TRAINING PROGRAM ON THE SUBJECT

2.1. The subject content

Training material is structured according to a module principle and consists of seven educational modules:

1. **module №1 „ Elements of Linear Algebra, Vector Algebra and Analytical Geometry. Complex Numbers.”,**
2. **module №2 „ Differential calculus of a function of one variable. Differential calculus of a function of several variables”,**
3. **module №3 „ Integral calculus of functions of one variable. ”,**
4. **module №4 „ Differential equations. Series ”,**
5. **module №5 „Multiple, Curvilinear and Surface Integrals. Elements of Field”,**
6. **module №6 „Theory of function of a complex variable. Operational calculus”,**
7. **module №7 „ Elements of Theory of Probability and Mathematical Statistics”**

each of which is a logically complete, relatively independent, holistic part of the academic discipline, which involves the assimilation of module test and analysis of the results of its implementation.

2.2. Module structuring and integrated requirements to each module

Module №1 „ Elements of Linear Algebra,Vector Algebra and Analytical Geometry. Complex Numbers.”

Integrated requirements to module №1. As a result of mastering the educational material of the educational module №1 the student must:

Know:

–definition and notation of determinants, matrices, systems of linear algebraic equations;

–Cramer's formulas;

– Gaussian method and matrix method for solving systems of linear algebraic equations;

– Kronecker-Capelli theorem;

–definition and properties of scalar, vector, mixed products of vectors;

–different types of equations of a line in a plane, a plane in space and a line in space;

–definition of a complex number, De’Moivrer's formula and extraction of the root of the nth degree from a complex number.

Be able to:

–investigate and solve systems of linear algebraic equations;

–perform linear operations with vectors;

–find the products of vectors and apply them to solving problems of geometry and physics;

–write different equations of the line;

–determine the angles between two lines, planes, between a line and a plane;

– write down the conditions of parallelism and perpendicularity of lines and planes;

–write a complex number in algebraic, trigonometric and exponential forms;

–perform operations on complex numbers.

Topic 1. Determinants and their applications.

Content. *Determinants of the 2nd and 3rd orders. Properties of determinants. Minors and algebraic additions. General definition of the determinant of the -th order. Calculation of determinants. Application of determinants to SLAR research. Cramer's formulas.*

Topic 2. Matrices.

Content. *Matrices, actions with them. Inverse matrix. Matrix equations. Rank of the matrix.*

Topic 3. Systems of linear algebraic equations.

Content. *System of linear algebraic equations, its compatibility, research of system compatibility by means of rank of matrices. Kronecker-Capelli theorem. SLAR solution methods (Cramer's, matrix, Gauss'). Homogeneous systems of linear algebraic equations.*

Topic 4. Vectors. Vector products.

Content. *Vectors, general definitions, linear actions with vectors. Linear dependence and independence of vectors. Basis. Projection of the vector on the axis. Coordinate systems on the plane and in space (RCSC, polar coordinate system). Coordinate method. Vectors in RCSC (coordinates, length, directing cosines). Segment division in this respect. Definitions, properties, calculations, coordinate form. Geometric meaning. Condition of perpendicularity and collinearity of two vectors, coplanarity of three vectors.*

Topic 5. Straight line on the plane.

Content. *General equation of the line, incomplete equations. Canonical and parametric equations of the straight line. A straight line that passes through two given points. Equation of a straight line in segments on axes. Straight line equation with angular coefficient. The angle between two lines, the conditions of parallelism and perpendicularity of two lines. The normal equation of a line. Distance from point to line.*

Topic 6. Plane and straight line in space.

Content. *Ways to define a plane in space. Types of plane equations. The angle between the planes. Conditions of parallelism and perpendicularity. The distance from the point to the plane. Straight line in space. Plane and line in space. Mutual location of the straight line and the plane. The angle between a straight line, a plane and a straight line. Conditions of parallelism and perpendicularity. The distance between parallel lines.*

Topic 8. Complex numbers.

Content. *The concept of a complex number. Actions on complex numbers in algebraic form. Geometric representation of complex numbers. Module and argument of a complex number. Trigonometric and exponential forms of a complex number. Actions on complex numbers in trigonometric form. De'Moivrer's formula. The formula for extracting the root of the n-th degree from a complex number.*

Module №2 „ Differential calculus of a function of one variable. Differential calculus of a function of several variables."

Integrated requirements to module №2. As a result of mastering the educational material of the educational module №2 the student must:

Know:

– task methods and classification of functions;

–determination of the boundary of the numerical sequence and the boundary of the function at the point;

–formulas of important boundaries and basic theorems about boundaries;

–determination of function continuity and classification of breakpoints;

–definition definition, table of derivatives and rules of differentiation;
–definition and properties of the differential;
–basic theorems of differential calculus;
–application of differential calculus to the study of functions;
–define the functions of many variables, the scope of its definition, boundaries and continuity;
–definition of partial derivatives, full differential function of many variables;
–application of partial derivatives.

Be able to:
- find the boundary of the function and investigate the function for continuity;
–find derivatives and differentials of different orders of basic elementary functions;
–find derivatives of compound functions, implicitly and parametrically given functions, perform logarithmic differentiation;
- to conduct a full study of the function and build its schedule.
–find partial derivative functions and full differential function of many variables;
–write the equation of the tangent plane and the normal to the surface;
–find the derivative by direction and gradient;
–find local extrema, the smallest and largest value of the function of two variables;
–find the conditional extremum of the function of two variables;

Topic 1. Sequences and functions. Limit of the *sequence*.
Content. *The concept of sequence. Sequence limit. Boundary theorems. Number e. Definite and indefinite expressions. The concept of function. Classification of functions. Function graphs.*
Topic 2. Limit of the function. Continuity of the function.
Content. *Limit of the function . Boundary theorems. Infinitely small and infinitely large quantities, the relationship between them. The first and second important boundaries.*
Comparison of infinitesimal quantities equivalent to infinitesimal quantities and their application to the calculation of boundaries.
Continuity of function, breakpoints and their classification. Properties of continuous functions at a point and on a segment.
Topic 3. Derivative of the function.
Content. *Derivative, its geometric, mechanical and physical meaning. The equation of tangent and normal. Differentiation and continuity. Rules of differentiation. Derivatives of elementary functions. Table of derivatives. Derivative of compound and inverse functions. Derivative of functions given implicitly or parametrically. Logarithmic differentiation.*
Topic 4. Differential of function. Principle theorems of differential calculus.
Content. *Function differential. Application. Derivatives and higher order differentials.*
Rolle's, Lagrange's, Cauchy's theorems. Taylor's, McLaurin's formulas. L'Hospital's rule.
Topic 5. Application of the derivative to the investigation of the function.
Content. *Monotonicity of the function. Extreme. Intervals of convexity and concavity, inflection points. Asymptotes. The largest and smallest values of the function. The general scheme of research of function and construction of its schedule*
Topic 6. Derivatives and differentials of the function of several variables.
Content. *Basic concepts and definitions. Partial and full growth. Partial derivatives of the first and higher orders. Differentiability of the function. Full differential function and its application. Derivative of a compound function. Full derivative. Differentiation of implicit function.*
Topic 9. Some applications of partial derivatives.
Content. *Tangent plane and normal to the surface. Derivative by direction. Gradient.*
Extreme function of two variables. Conditional extreme. The largest and smallest values of the function of two variables.

Module №3 „ Integral calculus of functions of one variable."

Integrated requirements to module №3. As a result of mastering the educational material of the educational module №3 the student must:

Know:

–definition of the indefinite integral and its properties;

–integrals of basic elementary functions and methods of integration of various functions;

–definition, conditions of existence and properties of the definite integral; Newton-Leibniz formula;

–application of a definite integral.

Be able to:

–apply methods of integration by parts and replacement of variable;

–integrate rational, fractional-rational, some irrational and trigonometric functions;

-calculate the areas of flat figures, the length of the curve arc, the volume of the body, the surface area of rotation, using a definite integral.

Topic 1. Indefinite integral.

Content. *Initial and indefinite integral. Properties. Table of basic integrals. Basic methods of integration. Direct integration*.

Variable replacement. Integration in parts. Classes of functions that integrate parts.

Topic 2. Integration of rational functions.

Content. *Polynomial, the root of the polynomial. Basic theorem of algebra. Decomposition of a polynomial into factors. Fractional rational functions. Correct and incorrect rational fractions. Elementary fractions. Decomposition of an incorrect fraction into the sum of a polynomial and a correct rational fraction*

Decomposition of a correct rational fraction into elementary fractions. Integration of elementary fractions. Integration of rational fractions.

Topic 3. Integration of trigonometric functions.

Content. *Methods of integration of trigonometric functions. Universal trigonometric substitution. Partial cases of rationalization of integrals from trigonometric functions.*

Topic 4. Integration of irrational functions.

Content. *Integration of expressions containing quadratic irrationalities. Integration of some irrational expressions.*

Topic 5. Definite integral.

Content. *Problems leading to the concept of definite integral. Definitions and properties. Geometric and physical content. Integral with variable upper bound. Newton-Leibniz formula. Calculation of definite integrals. Variable replacement. The formula of integration by parts.*

Topic 6. Improper integrals.

Content. *Implicit integrals with infinite limits of integration. Signs of convergence. Calculation.*

Improper integrals from unbounded functions. Signs of convergence. Calculation.

Topic 7. Applications of definite integrals.

Content. *Calculation of areas of flat figures. Area in rectangular Cartesian coordinates. Calculation of the area at parametric set of a contour. The area of a curved sector in polar coordinates. Curve's arc length. Body volume of rotation.*

Module №4 „ Differential equations. Series"

Integrated requirements to module №4. As a result of mastering the educational material of the educational module №4 the student must:

Know:

–Definition of the differential equation, the concept of general and partial solutions, general and partial integrals;

–Cauchy problem and geometric content of the differential equation;

–methods for solving the simplest types of first-order differential equations;

–methods of solving linear homogeneous and inhomogeneous differential equations of the second

order with constant coefficients;

–basic concepts of series theory;

–sufficient signs of convergence of sign-positive series;

–formulas for determining the radius of convergence of the power series;

–formulas of decomposition of a function into Taylor, MacLaurin and Fourier series.

Be able to:

–Solve differential equations with separable variables, homogeneous differential equations, linear first-order differential equations, Cauchy problem for equations of the specified types;

–solve linear homogeneous and inhomogeneous differential equations of the second order with constant coefficients;

–investigate numerical series for convergence;

–Find the region of convergence of power series;

-decompose the function into a series of Taylor, MacLaurin and Fourier.

Topic 1. Differential equations of the first order.

Content. *Basic concepts and definitions. Cauchy's problem. Theorem on the existence and unity of the solution. Geometric interpretation of the first order differential equation. Types of DE solutions.*

Topic 2 Methods to solve the differential equations of the first order..

Content. *DE with separated and detachable variables. Homogeneous DE (with a homogeneous right part).. Linear DE. Bernoulli's equation. DE in full differentials.*

Topic 3. Linear differential equations of the order higher than the first..

Content. *Linear differential equations. Linear homogeneous and non-homogeneous DE. Properties. The concept of a linearly independent system of functions. Vronsky's determinant. The structure of the general solution.*

Topic 4. Linear differential equations with constant coefficients.

Content. *Theory of linear homogeneous DE of the second and higher orders with constant coefficients. Linear inhomogeneous DE with constant coefficients and the right part of a special form. The method of indeterminate coefficients for linear DE of the second order.*

Linear non-homogeneous DE with constant coefficients and the right part of a special form. Lagrange method (variations of arbitrary constants) for linear DE of the second order.

Topic 5. Systems of differential equations.

Content. *The elimination method and integrable combinations for solving systems of differential equations in normal form. Algebraic method (Euler method) of solving systems of differential equations with constant coefficients*

Topic 6. Number series. Series with positive terms.

Content. *Basic concepts and definitions, convergence. Properties of numerical series. Harmonic series. A necessary condition for convergence. Sufficient condition of divergence.*

Topic 7. Sufficient tests for convergence series with positive terms

Content. *Comparison test, D'Alembert's test, radical and integral Cauchy's test.*

Topic 8. Series with arbitrary terms. Alternating series.

Content. *Alternating series. Character series. Leibniz's theorem. Absolute and conditional convergence of alternating series. Sufficient tests of convergence. Properties of absolutely convergent series.*

Topic 9. Functional series. Power series.

Content. *Basic concepts and definitions. Uniform convergence. Weierstrass' test. Properties of uniformly convergent series.*

Abel's theorem. The interval and radius of convergence of the power series.

Properties of power series. Taylor and MacLaurin series. Application of power series.

Topic 10. Fourier series.

Content. *Harmonic oscillations. Fourier trigonometric series. Fourier coefficients. A condition for*

representing a function through its Fourier series is sufficient. Fourier series for periodic functions. Fourier series for even and odd functions.

Fourier series for - periodic functions.

Module №5 "Multiple,Curvilinear and Surface Integrals. Elements of Field."

Integrated requirements to module №5. As a result of mastering the educational material of the educational module №5 the student must:

Know:

–definition of double and triple integrals, properties, geometric content, calculation;

–determination of properties, calculation of curvilinear integrals of the first and second kind;

–Green formula;

–definition, properties, methods of calculation of surface integrals of the first and second kind, Gauss-Ostrogradsky formula;

–concept of scalar and vector field;

–geometric field characteristics; scalar field gradient;

–flow, circulation, divergence, vector field rotor.

Be able to:

–calculate double and triple integrals;

–calculate curvilinear and surface integrals;

–find the flow, circulation, divergence and rotor of the vector field.

Topic 1. Double integrals.

Contents. *Basic concepts and definitions. Conditions of existence and properties. Calculation. Replacement of variables. Double integral in polar coordinates. Application.*

Topic 2. Triple integrals.

Content. *Basic concepts and definitions. Conditions of existence and properties. Calculation. Cylindrical and spherical coordinate systems. Replacement of variables in the triple integral. Application.*

Topic 3. Line integrals of the first order.

Content. *Definition of line integrals of the first kind. Geometric meaning. Properties and calculations. Application.*

Topic 4. Line integrals of the second order.Green's Formula.

Content. *Definition of curvilinear integrals of the second kind. Properties and calculations. Green's Formula. Conditions of independence of a line integral from the form of the integration path. Integration of complete differentials. Application.*

Topic 5. Surface integrals.

Content. *Definitions, properties and calculations. Ostrogradsky-Gauss formula. Stokes' formula.*

Topic 6. Elements of Field theory.

Content. *Scalar and vector fields. Scalar field gradient. Gradient properties. Derivative by direction. Vector flow through the surface.*

Field divergence. Circulation vector field. Vector rotor. Hamilton operator. First and second order differential operations. Some properties of vector fields. Vortexless, potential, solenoid fields.

Module №6 "The theory of the function of a complex variable. Operational calculus"

Integrated requirements to module №6. As a result of mastering the educational material of the educational module №6 the student must:

Know:

–Concept of the function of a complex variable;

–main elementary functions and their properties;

–Laplace transform and Laplace integral;

–properties of Laplace transform;

–Laurent series.

Be able to:

- perform operations with complex numbers;
- real and imaginary parts of the function;
-find the image of the known function of the original;
-find the original that matches the given image;
-solve the differential equation by the operating method.

Topic 1. Function of the complex variable. Basic elementary functions of the complex variable.

Content. *Complex numbers. Function of the complex variable, limit, continuity. Basic elementary functions. Definitions and properties*

Topic 2. Differentiation of the function of the complex variable.

Contents. *Differentiation of the function of the complex variable. Cauchy – Riemann conditions. Analytical functions. Harmonic functions.*

Topic 3. Integration of the function of the complex variable.

Content. *Integration of the function of the complex variable.*

Cauchy's integral theorem and Cauchy's formula. Initial analytical function.

Topic 4. Series in the complex domain. Isolated singular points. Residues.

Content. *Power series with complex terms. Taylor and Laurent series. Zero functions. Isolated singular points, their classification. Elements of the theory of residues and their application to the calculation of integrals.*

Topic 5. Laplace transform. Original and image functions..

Content. *The original and Laplace images, their properties, location. Theorems of unity and linearity. Theorems of shift, delay, advance. Differentiation and integration of the original and the image.*
Image of the periodic signal. Graph of step functions. Graph of function convolution. Duhamel's formula.

Topic 6. Inverse Laplace transform.

Content. *Finding the original of a fractional-rational function. Elementary means of finding originals. The first and second decomposition theorems.*

Topic 7 Application of Laplace transform.

Content. *Applying the Laplace transform to solve differential equations. Solving systems of linear differential equations.*

Module №7 «Elements of Theory of Probability and Mathematical Statistics.»

Integrated requirements to module №7. As a result of mastering the educational material of the educational module №7 the student must:

Know:

- basic formulas of combinatorics;
- basic concepts of probability theory and methods for calculating the probabilities of random events;
- laws of probability distribution of discrete and continuous random variables;
- the main characteristics of the system of two random variables;
- basic concepts of mathematical statistics.

Be able to:

- calculate the probabilities of random events;
- find the numerical characteristics of discrete and continuous random variables;
- to make the laws of distribution of two-dimensional random variable;
- find the characteristics of sample distributions;
- perform statistical analysis of the sample.

Topic 1. Random events. Definition of probability

Content. *Subject and methods of probability theory. Basic principles and formulas of combinatorics. The main types of random events. Classical and geometric definition of probabilities. Relative frequency and statistical probability of the event.*

Topic 2. Additive and multiplicative law of probability. Formula of total probability. Bayes' formula.

Content. *Probability addition theorem for incompatible events. Dependent and independent random events. Conditional probability. Probability multiplication theorems. Addition theorems for compatible events. Probabilities of hypotheses. Full probability formula, Bayesian formula.*

Topic 3. Repeated independent tests. Bernoulli's formula

Content. *Repeated independent tests. Bernoulli's scheme. Bernoulli's formula. The most probable number of occurrences of the event. Boundary theorems of the Bernoulli scheme: Poisson's theorem, local and integral Moivre-Laplace theorems. Probability of deviation of relative frequency from probability.*

Topic 4. Discrete random variables and their basic numerical characteristics. Distribution laws.

Content. *Random variables. Discrete random variables (DRV). Distribution laws, methods of assignment, distribution function. Numerical characteristics of DRV: mathematical expectation, variance, standard deviation, their properties. Poisson distribution, binomial, geometric, hypergeometric laws of DRV distribution.*

Topic 5. Continuous random variables and their basic numerical characteristics. Distribution function and distribution density. Distribution laws

Content. *Continuous random variables (CRV). Function and density of distribution, their properties. Numerical characteristics: mathematical expectation, variance, standard deviation. Laws of distribution of CRV: uniform, exponential, normal. The probability of a random variable falling into the interval. The rule of three sigma.*

Topic 6. General population and sample. Numerical characteristics

Content. *General population and sample. Variation series. Statistical distribution of the sample. Polygon and histogram, empirical distribution function. Numerical characteristics of the statistical distribution of the sample.*

Topic 7. Point statistical estimates of distribution parameters. Interval statistical estimates

Content. *Point and interval statistical estimates of distribution parameters.*

Topic 8. Statistical hypotheses. Statistical criterion. Construction of the critical area. Criterion's power

Content. *Statistical hypotheses. Statistical criterion. Construction of the critical area. Criterion's power. General algorithm for testing statistical hypotheses. Parametric and nonparametric statistical hypotheses.*

2. SUBJECT CONTENT

2.3. Training schedule of the subject

№	Theme (thematic section)	Total, hours			
		Full-time			
		Total	Lecture	Practice	Self-Study
1	2	3	4	5	6
The first semester					
Module №1 „ Elements of Linear Algebra,Vector Algebra and Analytical Geometry. Complex Numbers."					
1.1	Determinants and their applications.	8	2	2	4
1.2	Matrices.	8	2	2	4
1.3	Systems of linear algebraic equations.	12	2	2 2	6

1.4	Vectors. Vector products.	14	2 2	2 2	6
1.5	Straight line on the plane.	12	2	2 2	6
1.6	Plane and straight line in the space.	12	2	2 2	6
1.7	Complex Numbers.	10	2	2	6
1.8	Homework №1.1	4	–	–	4
1.9	Module test №1	3	–	2	1
Total by the module №1		**83**	**16**	**24**	**43**
Module №2 „ Differential calculus of a function of one variable. Differential calculus of a function of several variables ”					
2.1	Sequences and functions. Limit of the sequence.	8	2	2	4
2.2	Limit of the function. Continuity of the function.	16	2 2	2 2 2	6
2.3	Derivative of the function.	12	2 2	2 2	4
2.4	Differential of the function. Principle theorems of differential calculus.	10	2	2 2	4
2.5	Application of the derivative to the investigation of the function.	10	2	2 2	4
2.6	Derivatives and differentials of functions of several variables.	8	2	2	4
2.7	Some applications of partial derivatives.	12	2	2 2	6
2.8	Homework №1.2	4	–	–	4
2.9	Module test №2	2	–	1	1
Total by the module №2		**82**	**18**	**27**	**37**
In total by the first semester		**165**	**34**	**51**	**80**
The second semester					
Module №3 „ Integral calculus of functions of one variable. ”					
3.1	Indefinite integral.	10	2	2 2	4
3.2	Integration of rational functions.	10	2	2 2	4
3.3	Integration of trigonometric functions	8	2	2	4
3.4	Integration of irrational functions.	8	2	2	4
3.5	Definite integral.	8	2	2	4
3.6	Improper integrals.	10	2	2 2	4
3.7	Applications of definite integrals.	8	2	2	4
3.8	Homework №2.1	4	–	–	4
3.9	Module test №3	3	–	2	1
Total by the module №3		**69**	**14**	**22**	**33**
Module №4 „ Differential equations. Series ”					

4.1	Differential equations of the first order.	10	2	2 2	4
4.2	Methods to solve the differential equations of the first order.	12	2 2	2 2	4
4.3	Linear differential equations of the order higher than the first.	10	2	2 2	4
4.4	Linear differential equations with constant coefficients.	8	2	2	4
4.5	Systems of differential equations.	6	0	2	4
4.6	Number series. Series with positive terms	6	2	2	2
4.7	Sufficient tests for convergence series with positive terms	8	2	2	4
4.8	Series with arbitrary terms. Alternating series.	8	2	2	4
4.9	Functional series. Power series.	12	2	2 2	6
4.10	Fourier series.	10	2	2	6
4.11	Homework №2.2	4	–	–	4
4.12	Module test №4	2	–	1	1
Total by the module №4		**96**	**20**	**29**	**47**
In total by the second semester		**165**	**34**	**51**	**80**
The third semester					
Module №5 „ Multiple,Curvilinear and Surface Integrals. Elements of Field ”					
5.1	Double integrals	12	2 2	2 2	4
5.2	Triple integrals	8	2	2	4
5.3	Line integrals of the first order	6	2	2	2
5.4	Line integrals of the second order. Green’s Formula.	6	2	2	2
5.5	Surface integrals	8	2	2	4
5.6	Elements of Field Theory. Scalar fields.	12	2 2	2 2	4
5.7	Homework №3.1	4	–	–	4
5.8	Module test №5	3	–	2	1
Total by the module №5		**59**	**16**	**18**	**25**
Module №6 „ The theory of the function of a complex variable. Operational calculus ”					
6.1	Function of the complex variable. Basic elementary functions of the complex variable.	4	2	0	2
6.2	Differentiation of the functions of the complex variable.	6	2	2	2
6.3	Integration of the function of the complex variable. Integrating Couchy’s formula.	10	2 2	2	4
6.4	Series in the complex domain. Taylor series and Laurent series. Isolated singular points. Residues.	6	2	2	2
6.5	Laplace transform. Original and image functions.	12	2 2	2 2	4

6.6	Inverse Laplace transform.	8	2	2	4
6.7	Applications of Laplace transform.	8	2	2	4
6.8	Homework №3.2	4	–	–	4
6.9	Module test №6	3	–	2	1
Total by the module №6		**61**	**18**	**16**	**27**
In total by the third semester		**120**	**34**	**34**	**52**
The fourth semester					
Module №7 „Elements of Theory of Probability and Mathematical Statistics."					
7.1	Random events. Definition of probability.	14	2	2 2	8
7.2	Additive and multiplicative law of probability. Formula of total probability. Bayes' formula.	18	2	2 2 2	10
7.3	Repeated independent trials. Bernoulli's formula.	16	2	2 2	10
7.4	Discrete random variables and their basic numerical characteristics. Distribution laws.	14	2	2 2	8
7.5	Continuous random variables and their basic numerical characteristics. Distribution function and distribution density. Distribution laws.	16	2	2 2	10
7.6	General population and sample. Numerical characteristics.	14	2	2 2	8
7.7	Point statistical estimates of distribution parameters. Interval statistical estimates.	12	2	2	8
7.8	Statistical hypotheses. Statistical criterion. Construction of the critical area. Criterion's power.	12	2	2 2	6
7.9	Homework №4	8	–	–	8
7.10	Module test №7	11	1	2	8
In total by the fourth semester		**135**	**17**	**34**	**84**
In total by the discipline		**585**	**119**	**170**	**296**

2.4. Homework

Homeworks 1.1, 1.2, 2.1, 2.2, 3.1, 3.2, 4 are performed in the first and the second semester. The purpose of homework: to improve theoretical knowledge and practical skills while studying the material of training modules.

Performance, execution, design and defense of homework is carried out by the student individually in accordance with the guidelines.

The time required to complete each homework 1.1, 1.2, 2.1, 2.2, 3.1, 3.2 is up to 4 hours of independent work and homework 4 is up to 8 hours .

2.5. Questions list for the examination

The list of questions and content of tasks for preparation for the exam are developed by the leading teacher of the department in accordance with the course training program, approved at the meeting of the department and distributed among students.

3. Basic concepts of guidance on the subject

3.1. Teaching methods

The following teaching methods are used in the study of the discipline:

- explanatory and illustrative method;
- method of problem presentation;
- reproductive method;
- research method.

The implementation of these methods is carried out during lectures, demonstrations, independent problem solving, work with educational literature, analysis and solving economic problems.

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4. RATING SYSTEM OF KNOWLEDGE AND SKILLS ASSESSMENT

4.1. Assessment of certain kinds of student academic work is carried out in accordance with table 4.1.

Table 4.1

Kind of Academic Work	Maximum Grade Values
	The first semester
Solving problems, answering theoretical questions during classroom work	**Modules №1, №2**
	8 (the total)
Performing and protection of homework 1.1 (1.2)	8
For carrying out a module test №1 (№2), a student must receive not less	*10 point*
Module Test №1 (№2)	24
Total for the Module №1 (№2)	**40**
Total for the Module №1 and №2	**80**
Semester Examination	**20**
Total for the first semester	**100**
	The second semester
Solving problems, answering theoretical questions during classroom work	**Modules №3 (№4)**
	16 (the total)
Performing and protection of homework 2.1 (2.2)	10

For carrying out a module test №1 (№2), a student must receive not less	*16 point*
Module Test №3 (№4)	24
Total for the Module №3 (№4)	**50**
Total for the Module №3 and №4	**100**
Total for the second semester	**100**
	The third semester
Solving problems, answering theoretical questions during classroom work	**Modules №5 (№6)**
	16 (the total)
Performing and protection of homework 3.1 (3.2)	10
For carrying out a module test №1 (№2), a student must receive not less	*16 point*
Module Test №5 (№6)	24
Total for the Module №5 (№6)	**50**
Total for the Module №5 and №6	**100**
Total for the third semester	**100**
	The fourth semester
Solving problems, answering theoretical questions during classroom work	**Modules №7**
	24 (the total)
Performing and protection of homework 4	26
For carrying out a module test №1 (№2), a student must receive not less	*30 point*
Module Test №7	30
Total for the Module №7	**80**
Semester Examination	**20**
Total for the fourth semester	**100**

4.2. Completed types of educational work are credited to the student, if he received a positive rating for them.

4.3. The sum of rating assessments received by the student for certain types of completed academic work is the current modular rating assessment, which is recorded in the module control.

4.4. The final semester rating is converted into a grade on the national scale and the ECTS scale.

4.5. The final semester rating in points, on the national scale and the ECTS scale is entered in the test report, study card and individual curriculum of the student (record book), for example, as follows: ***92 / Excellent / A, 87 / Good / B, 79 / Good / C, 68 / Sat./D, 65 /Sat./E, etc.***

4.6. The Total Grade for the subject is equal to the average grade from Total Semester Grades with its further transformation into national scale and ECTS system.

The Total Grade is recorded to the Diploma Appendix.

(Ф 03.02 – 01)

АРКУШ ПОШИРЕННЯ ДОКУМЕНТА

№ прим.	Куди передано (підрозділ)	Дата Видачі	П.І.Б. отримувача	Підпис отримувача	Примітки

(Ф 03.02 – 02)

АРКУШ ОЗНАЙОМЛЕННЯ З ДОКУМЕНТОМ

№ пор.	Прізвище ім'я по-батькові	Підпис ознайомленої особи	Дата ознайом-лення	Примітки

(Ф 03.02 – 04)

АРКУШ РЕЄСТРАЦІЇ РЕВІЗІЇ

№ пор.	Прізвище ім'я по-батькові	Дата ревізії	Підпис	Висновок щодо адекватності

(Ф 03.02 – 03)

АРКУШ ОБЛІКУ ЗМІН

№ Зміни	№ листа (сторінки)				Підпис особи, яка внесла зміну	Дата внесення зміни	Дата введення зміни
	Зміненого	Заміненого	Нового	Анульо-Ваного			

(Ф 03.02 – 32)

УЗГОДЖЕННЯ ЗМІН

	Підпис	Ініціали, прізвище	Посада	Дата
Розробник				
Узгоджено				