Додаток 2
До Процедури розробки та періодичного перегляду освітніх програм

1. General Information	
Faculty	Faculty of Foreign Students; Faculty of Pharmacy
Programme	22 Healthcare, 226 Pharmacy, Industrial Pharmacy, the 2nd (master) level of higher education, full-time
Academic year	2023-2024
Subject	Higher Mathematics and Statistics OK-9 Kaf_biophysics@meduniv.lviv.ua
Department	Department of Biophysics 79010, Lviv, 3a Shymzeriv tel.: +38 (032) 275-58-76 Kaf_biophysics@meduniv.lviv.ua
Head of the Department	Roman Fafula, Dr.Sci., Professor, Kaf_biophysics@meduniv.lviv.ua
Year	I
Semester	I-II
Type of the Subject	obligatory
Professors	Oksana MALANCHUK, Ph.D. in Physical and Mathematical Science, Associate Professor, oksana.malan@gmail.com;
Erasmus	–
Responsible for Syllabus	Oksana MALANCHUK, Ph.D. in Physical and Mathematical Science, Associate Professor, oksana.malan@gmail.com;
Credits ECTS	4
Hours	In total – 120 h.: lectures — 14 h.; practical classes – 46 h.; individual work – 60 h.
Language of study	English
Consultations	According to the schedule

2. Brief review of the subject

According to the educational and professional program, the discipline "Higher mathematics and statistics" is one of the fundamental general education disciplines that form the theoretical basis for trainingof highly qualified specialists for pharmacy.

Higher mathematics and statistics studies the elements of higher mathematics, the basics of probability theory and mathematical statistics used in pharmacy. In the process of studying the discipline, students master the theory and practice of pharmaceutical and medical-biological information analysis.

Study by students of the main principles and theoretical foundations of higher mathematics and statistics, modeling of pharmaceutical processes by differential equations, description and evaluation of distribution laws for discrete and continuous random variables, processing of pharmaceutical research data using statistical methods allows learning scientific argumentation, and also develops the ability to consistently and logically think.

According to the curriculum, the discipline "Higher Mathematics and Statistics" is divided into 2 sections, which consist of a lecture course (14 hours), practical classes (46 hours) and independent work of students (60 hours).

3. Purpose and objectives of the course

The purpose of learning the academic discipline "Higher Mathematics and Statistics" is to acquaint students with the basics of modern mathematical apparatus, necessary for solving theoretical and applied medical and biological problems, forming in them the ability to perform mathematical analysis of pharmacokinetic processes; promote the development of logical thinking.

Studying the discipline “Higher mathematics and statistics” students learn the theory and practice of analysis of pharmaceutical and biomedical information. Students learn to analyze and solve pharmaceutical and medical-biological problems, individually use appropriate mathematical literature. Mathematical education promotes abstract thinking, the ability to systematically analyze the phenomenon. The basic knowledge of mathematics of a school is necessary for studying the discipline.

The goals of studing the discipline “Higher mathematics and statistics” are:

- ✓ learning of basic principles and theoretical principles of higher mathematics and statistics;
- ✓ modeling of pharmaceutical processes by differential equations;
- ✓ description and assessment of probability distributions for discrete and continuous random variables;
- ✓ processing of data of pharmaceutical researches by statistical methods;

Achieving these objectives will allow a pharmaceutical students to master the mathematical knowledge and skills which are necessary for training a pharmacist and for study of other theoretical and applied academic disciplines in the higher medical and pharmaceutical educational establishments and ensure the formation of general and special competencies and learning outcomes.

Integral competence:

The ability to solve common and complex specialized tasks and practical problems in professional activities using pharmaceutical regulations, theories and methods of fundamental, chemical, technological, biomedical, social and economic sciences; integrate knowledge and handle complexity, formulate judgments with incomplete or limited information; clearly and unambiguously communicate their findings and knowledge rationale underpinning these, to professional and non professional audience.

General competences*:*

– ***general:***

GC01. Ability to abstract thinking, analysis and synthesis.

GC03. Ability to communicate in the national language both orally and in writing.

GC04. Ability to communicate in a foreign language (mainly English) at a level that ensures effective professional activity.

GC05. The ability to evaluate and ensure the quality of the work performed.

GC09. Ability to use information and communication technologies.

– ***special (professional) competitions:***

PC01. Ability to integrate knowledge and solve complex pharmacy/industrial pharmacy problems in broad or multidisciplinary contexts.

PC03. Ability to solve pharmacy problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility.

PC13. The ability to organize the activities of pharmacies to provide the population and health care facilities with medicines and other products of the pharmacy range under normal conditions and under emergency conditions, as well as to implement appropriate reporting and accounting systems in them, to carry out commodity analysis, administrative record keeping taking into account requirements of pharmaceutical legislation.

PC14. The ability to analyze and forecast the main economic indicators of the activity of pharmacies, to calculate the main taxes and fees, to form prices for medicines and other products of the pharmacy assortment in accordance with the legislation of Ukraine.

PC15. The ability to analyze socio-economic processes in pharmacy, forms, methods and functions of the system of pharmaceutical provision of the population and its components in global practice, indicators of the need, effectiveness and availability of pharmaceutical care in terms of medical

insurance and reimbursement of the cost of medicines.

Integrative final program learning outcomes (PLO) of the discipline "Higher Mathematics and Statistics" are:

PLO01. Possess specialized conceptual knowledge in the field of pharmacy and related fields, taking into account modern scientific achievements, and be able to apply them in professional activities. (GC01, GC05, GC09, PC01, PC03, PC13, PC14, PC15)

PLO03. Possess specialized knowledge and abilities/skills for solving professional problems and tasks, including for the purpose of improving knowledge and procedures in the field of pharmacy. (GC01, GC05, GC09, PC01, PC03, PC13, PC14, PC15)

PLO04. Communicate freely in the national and English languages orally and in writing to discuss professional problems and results of activities, presentation of scientific research and innovative projects. (GC03, GC04)

PLO05. Assess and ensure the quality and efficiency of activities in the field of pharmacy in standard and non-standard situations; adhere to the principles of deontology and ethics in professional activity (GC01, GC05, GC09, PC01, PC03, PC13, PC14, PC15).

PLO06. Develop and make effective decisions to solve complex/complex problems of pharmacy personally and based on the results of joint discussion; formulate the goals of one's own activity and the activity of the team, taking into account public and industrial interests, the general strategy and existing limitations, determine the optimal ways to achieve goals. (GC01, GC05, GC09, PC01, PC03, PC13, PC14, PC15)

PLO07. Analyze the necessary information on the development and production of medicinal products, using professional literature, patents, databases and other sources; systematize, analyze and evaluate it, in particular, using statistical analysis. (GC01, GC03, GC04, GC09, PC01, PC03, PC13, PC14, PC15)

PLO09. Formulate, argue, clearly and concretely convey to specialists and non-specialists, including those seeking higher education, information based on one's own knowledge and professional experience, the main trends in the development of world pharmacy and related industries. (GC01, GC03, GC04, GC05, GC09, PC01, PC03, PC13, PC14, PC15)

PLO16. Implement appropriate organizational management measures to provide the population and health care institutions with medicines and other products of the pharmacy assortment; to carry out all types of reporting and accounting in pharmacies, administrative records and commodity analysis (GC01, GC05, GC09, PC01, PC03, PC13, PC14, PC15)

PLO17. Calculate the main economic indicators of pharmacy establishments, as well as taxes and fees. Form all types of prices (purchasing, wholesale and retail) for medicinal products and other products of the pharmacy assortment. (GC01, GC05, GC09, PC01, PC14)

PLO23. Determine the main chemical and pharmaceutical characteristics of medicinal products; choose and/or develop quality control methods for the purpose of their standardization using physical, chemical, physicochemical, biological, microbiological and pharmacotechnological methods in accordance with current requirements. (GC01, GC05, GC09, PC01, PC03, PC13).

4. Preliminary requirements

1. Knowledge of basic concepts, formulas and the ability to apply differential and integral calculus for a high school mathematics course.
2. Knowledge of elements of combinatorics, beginnings of probability theory and elements of mathematical statistics from a high school mathematics course, ability to apply to solving simple problems.
3. The ability to think abstractly, analyze and synthesize knowledge.
4. Ability to apply knowledge in practical activities.
5. Ability to search, process and analyze information from various sources.

5. Final program learning outcomes

Learning outcomes

Code	Outcomes	Matrix of competencies
ЗН-1	limits of numerical sequences and functions, basis of differential calculus and its application;	*ПРН01, ПРН03, ПРН04, ПРН 09.*

ЗН-2	basics of integral calculus and its application;	*ПРН01, ПРН03, ПРН04, ПРН 09.*
ЗН-3	theory of differential equations; modeling of processes by differential equations;	*ПРН01, ПРН03, ПРН09, ПРН23.*
ЗН-4	theory of probabilities as the basis of genetics, metrology, mathematical statistics; basic laws of distribution of random variables and their characteristics;	*ПРН01, ПРН03, ПРН04, ПРН06, ПРН07, ПРН17*
ЗН-5	methodology for evaluating the law and characteristics of the distribution of the studied characteristic according to the sample data;	*ПРН05, ПРН06, ПРН07, ПРН09, ПРН16, ПРН17*
ЗН-6	methodology of statistical testing of hypotheses; basics of the theory of dispersion, correlation and regression analysis	*ПРН05, ПРН07, ПРН16, ПРН17, ПРН23.*
УМ-1	determine the characteristics of the studied phenomenon on the basis of differential calculus; calculate limits of functions; study of continuity of functions; calculate measurement errors;	*ПРН01, ПРН03, ПРН04, ПРН 09.*
УМ-2	calculate and apply integral characteristics;	*ПРН01, ПРН03, ПРН04, ПРН 09.*
УМ-3	obtain solutions of differential equations; to model processes with differential equations;	*ПРН01, ПРН03, ПРН09, ПРН23.*
УМ-4	determine the probabilities of random events and characteristics of the distribution of random variables;	*ПРН01, ПРН03, ПРН07, ПРН17*
УМ-5	estimate point and interval values of the characteristics of the distribution of the characteristic under study;	*ПРН01, ПРН04, ПРН07, ПРН17*
УМ-6	analyze the significance of the influence of the factor on the change in the law of distribution and characteristics of the distribution of the investigated characteristic; calculate the correlation between system features, estimate the parameters of the regression function model by the method of least squares.	*ПРН05, ПРН06, ПРН07, ПРН09, ПРН16, ПРН17, ПРН23*
К-1	ability to apply knowledge in practical situations;	*ПРН01, ПРН03, ПРН05, ПРН09, ПРН16, ПРН17, ПРН23.*
К-2	ability to carry out research at the appropriate level.	*ПРН04, ПРН06, ПРН07, ПРН17, ПРН23.*
АВ-1	experience of individual subject activity, educational-cognitive, analytical, ability to synthesis of knowledge;	*ПРН01, ПРН03, ПРН06, ПРН09* .
АВ-2	ability to self-study and continue professional development;	*ПРН04, ПРН07, ПРН16, ПРН17.*
АВ-3	ability to control, self-control of learning outcomes.	*ПРН05, ПРН06, ПРН07, ПРН23.*

6. Course content

Course	full-time form of study	
Classes	**Hours**	**Number of groups**
Lectures (L)	14	
Practical classes (PC)	44	

Individual work (IW)		60		
7. Course content				
Code	**Topic**	**Content**	**Code**	**Professors**
L-1	Differential calculus.	The derivative of a function. Differential function. Partial derivative. Partial and total differentials.	ЗН-1, К-1 АВ-1	Oksana Malanchuk
L-2	Integral calculus.	Indefinite integral. Properties of the indefinite integral. The definite integral. Newton-Leibnitz formula. Properties of the definite integral. Improper integrals.	ЗН-2 К-1 АВ-1	Oksana Malanchuk
L-3	Differential equations..	Basic concepts of the theory of differential equations. Modeling by differential equations of processes in physics, chemistry, biology and medicine.	ЗН-3, К-1 АВ-1	Oksana Malanchuk
L-4	Analysis of random variables. Laws of distribution of random variables.	A random variable. Methods of setting the distribution law for random variables. Distribution function. Distribution density function. Distribution characteristics. Normal distribution law.	ЗН-4 ЗН-5 К-1 К-2 АВ-1 АВ-2	Oksana Malanchuk
L-5	Limit laws of the theory of probabilities. Analysis of variation series.	A set of independent random variables. Chebyshov's inequalities. The law of large numbers in the form of Chebyshov and its application in metrology. Central limit theorem. General and selective population. Point and interval evaluations of the characteristics of the investigated feature.	ЗН-5 К-1 К-2 АВ-1 АВ-2	Oksana Malanchuk
L-6	Statistical testing of hypotheses. Analysis of variance. Correlation and regression analysis. Basic concepts of dispersion analysis. Univariate variance analysis for a parametric model.	Formulation of hypotheses. Verification criterion. Errors of the first and second kind. Formulation of a statistical conclusion. Parametric and non-parametric methods. A general consideration of testing hypotheses about the equality of parameters of independent populations.	ЗН-6 К-1 К-2 АВ-1 АВ-2	Oksana Malanchuk
L-7	Correlation dependence. Regression equation.	Estimating the correlation coefficient based on sample data and analyzing its significance.	ЗН-6 К-1 К-2 АВ-1 АВ-2	Oksana Malanchuk
PC-1	Differentiation of functions. Application of the derivative.	Derivative of sum, product, quotient of functions. The derivative of a composite function. Derivatives of higher orders. Optimization tasks in pharmacy and medicine.	ЗН-1 УМ-1 К-1 АВ-1 АВ-2	Oksana Malanchuk
PC-2	Application of the differential.	Finding differentials of functions of the first and higher orders. Calculation of the increment of the function and its comparison with the differential. Application of the differential for linear function approximation and approximate	ЗН-1 УМ-1 К-1 К-2 АВ-1 АВ-2	Oksana Malanchuk

		calculations. Application of the differential to estimate the marginal error of average measurements		
PC-3	Differentiation of functions of many variables.	Finding partial derivatives of the first and higher orders. Calculations of partial and total differentials of functions and their comparison with the corresponding increments of the function. Application of the full differential: for linear approximation of the function, approximate calculations and the marginal error of intermediate measurements.	ЗН-1 УМ-1 К-1 К-2 АВ-1 АВ-2	Oksana Malanchuk
PC-4	Methods of integration.	Direct integration. Integration by the method of variable substitution. Method of integration by parts.	ЗН-2 УМ-2 К-1 АВ-1 АВ-2	Oksana Malanchuk
PC-5	The definite integral and its application. Improper integrals.	Calculation of definite integrals. Analysis of improper integrals. Application of the definite integral for solving problems in pharmacy, biology, and medicine.	ЗН-2 УМ-2 К-1 К-2 АВ-1 АВ-2 АВ-3	Oksana Malanchuk
PC-6	Solving differential equations.	Differential equations of the first order with separable variables. Linear homogeneous differential equations of the first order. Linear homogeneous differential equations of the second order with constant coefficients. Finding general and partial solutions.	ЗН-3 УМ-3 К-1 К-2 АВ-1 АВ-2 АВ-3	Oksana Malanchuk
PC-7	Modeling of physico-chemical and biological processes by differential equations.	Physical processes: free oscillations, body cooling, diffusion, absorption of light and ionizing radiation, radioactive decay.	ЗН-3 УМ-3 К-1 К-2 АВ-1 АВ-2	Oksana Malanchuk
PC-8	Modeling of pharmaceutical and pharmacokinetic processes by differential equations.	Kinetics of chemical reactions. Processes in pharmacy, biology, medicine.	ЗН-3 УМ-3 К-1 К-2 АВ-1 АВ-2	Oksana Malanchuk
PC-9	Probabilities of random events. Analysis of discrete random variables.	Random event. Determining the probability of a random event. Conditional probability. Formula of total probability. Bayes formula. Series of distribution, polygon of distribution, probability function of discrete random variable.	ЗН-5 УМ-5 К-1 К-2 АВ-1 АВ-2 АВ-3	Oksana Malanchuk
PC-10	The distribution function of a random variable.	Calculations of probabilities of random variables according to the distribution function. Finding quantiles by distribution	ЗН-5 УМ-5 К-1	Oksana Malanchuk

		function.	К-2 АВ-1 АВ-2 АВ-3	
РС-11	The density function of the distribution of a random variable.	Calculation of probabilities of a random variable as a function of density.	ЗН-5 УМ-5 К-1 К-2 АВ-1 АВ-2 АВ-3	Oksana Malanchuk
РС-12	Calculations of distribution characteristics: mathematical expectation, dispersion, standard deviation.	Calculations of distribution characteristics: mathematical expectation, variance, standard deviation.	ЗН-5 УМ-5 К-1 К-2 АВ-1 АВ-2 АВ-3	Oksana Malanchuk
РС-13	Basic laws of distribution of discrete random variables.	Solving problems based on the binomial distribution law. Application of Moivre-Laplace approximation formulas and Poisson's formula. Polynomial distribution.	ЗН-5 УМ-5 К-1 К-2 АВ-1 АВ-2 АВ-3	Oksana Malanchuk
РС-14	Basic laws of distribution of continuous random variables.	Problems on uniform, exponential and normal distribution laws. Using tables of the standard normal distribution.	ЗН-5 УМ-5 К-1 К-2 АВ-1 АВ-2 АВ-3	Oksana Malanchuk
РС-15	Analysis of variation series.	Construction of a discrete variational series. Construction of an interval variational series, empirical distribution density function, empirical distribution function. Graphic representation of variational series.	ЗН-5 УМ-5 К-1 К-2 АВ-1 АВ-2 АВ-3	Oksana Malanchuk
РС-16	Estimating the parameters of the distribution of the investigated characteristic. Confidence interval	Determination of the probability interval for the mathematical expectation, variance and standard deviation of a discretely distributed characteristic, for a normally distributed characteristic.	ЗН-5 УМ-5 К-1 К-2 АВ-1 АВ-2 АВ-3	Oksana Malanchuk
РС-17	Algorithms for statistical testing of hypotheses.	Checking the sample for homogeneity. Checking the method of analysis for the presence of a systematic error. Comparison of the new analysis method with the standard one in terms of reproducibility.	ЗН-6 УМ-6 К-1 К-2 АВ-1 АВ-2 АВ-3	Oksana Malanchuk

PC -18	Check about the law of distribution.	Shapiro-Wilk test. Pearson's agreement criterion.	ЗН-6 УМ-6 К-1 АВ-1 АВ-2	Oksana Malanchuk
PC -19	Statistical hypotheses testing.	Study of influence of the factor on displacement of the characteristic distribution center. Testing statistical hypothesis about equality of variances and distribution centers of two independent normal samples.	ЗН-6 УМ-6 К-2 АВ-3	Oksana Malanchuk
PC -20	Nonparametric methods for assessing the significance of the results.	Mann-Whitney test. Pearson's χ^2 method.	ЗН-6 УМ-6 К-2 АВ-3	Oksana Malanchuk
PC -21	Univariate analysis of variance.	Parametric model of univariate analysis of variance. Experiment planning, formulating hypotheses and their statistical testing.	ЗН-6 УМ-6 К-1 К-2 АВ-1 АВ-2 АВ-3	Oksana Malanchuk
PC 22	Correlation analysis.	Correlation field. Empirical regression line. Estimation of the correlation coefficient and analysis of significance of linear correlation.	ЗН-6 УМ-6 К-1 К-2 АВ-1 АВ-2 АВ-3	Oksana Malanchuk
PC-23	Modeling regression equation.	Modeling correlation between characteristics and factors using least square method. Linear regression model. Analysis of linear correlation significance using analysis of variance.	ЗН-6 УМ-6 К-1 К-2 АВ-1 АВ-2 АВ-3	Oksana Malanchuk
IW-1	Calculation of limit of a function.	The limit of a function. Infinitely small and infinitely large functions. Theorems about limits. Techniques of the limit calculation.	ЗН-1 УМ-1 К-1 АВ-2	Oksana Malanchuk
IW-2	Analysis of function continuity.	Continuity of a function. Main properties of continuous function. Asymptotes of a function: vertical, slant, horizontal.	ЗН-1 УМ-1 К-1 АВ-2	Oksana Malanchuk
IW-3	Applications of differential of one variable function.	Basic theorems of differential calculus: Fermat’s theorem, Rolle’s theorem. Total analysis of the function. Evaluation of limits with indeterminate forms using l’Hopital’s rule.	ЗН-1 УМ-1 К-1 АВ-2	Oksana Malanchuk
IW-4	Application of differential calculus to find limits.	Application of differential calculus to find limits. Lopital's rules	ЗН-1 УМ-1 К-1 АВ-2	Oksana Malanchuk

IW -5	Complete analyze of the functions of one variable.	Plotting graphs.	ЗН-1 УМ-1 К-1 АВ-2	Oksana Malanchuk
IW -6	Multivariable function.	Conditions for the convergence of a sequence of points in Euclidean space. Function limit of many variables. Continuity of multivariable function.	ЗН-1 УМ-1 К-1 АВ-2	Oksana Malanchuk
IW -7	Application of differential calculus to the study of multivariable functions.	Investigation of the extremum of the two variables function. Least squares method. Calibration graph and its equations.	ЗН-1 УМ-1 К-1,2 АВ-2	Oksana Malanchuk
IW -8	Integral calculus.	Calculation of area of a figure. The distance traveled in irregular motion. Work done by a variable force. Volume of the population. The product of a chemical reaction. The dose of radiation exposure. Integral spectral characteristics of radiation sources. Application of mean value theorem.	ЗН-2 УМ-2 К-1 АВ-2	Oksana Malanchuk
IW -9	Differential equations.	Linear inhomogeneous first-order differential equations. Linear equations of the second order that allow decreasing order. General and partial solutions.	ЗН-3 УМ-3 К-1,2 АВ-1,2	Oksana Malanchuk
IW -10	Modeling of processes by differential equations.	Models of reproduction dynamics, epidemic dynamics. Graphic representation of process dependence on time.	ЗН-3 УМ-3 К-1 АВ-2	Oksana Malanchuk
IW -11	The characteristics of the distribution of discrete random variables in Excel.	The characteristics of the distribution of discrete random variables in Excel.	ЗН-5 УМ-5 К-1 АВ-2 АВ-3	Oksana Malanchuk
IW -12	The construction of discrete variation series in Excel.	Graphical representation of variation series. Construction of a distribution polygon and a distribution function of a random variable.	ЗН-5 УМ-4 УМ-5 К-1 АВ-2	Oksana Malanchuk
IW -13	Limit laws of probability theory.	Application of Chebyshev's theorem in the theory of measurements, the central limit theorem.	ЗН-5 УМ-5 К-2 АВ-2	Oksana Malanchuk
IW -14	The laws of distribution of statistics of a sample.	Pearson's distribution. Student's distribution. Fisher-Snedekor distribution. Sample statistics that are subject to these distributions. Using Pearson, Student, Fisher-Snedekor distribution tables.	ЗН-4 УМ-4 К-2 АВ-1	Oksana Malanchuk
IW	Analysis of variation	Construction of frequency distribution.	ЗН-4	Oksana

-15	series in Excel.	Graphical representation of the empirical density function and the empirical distribution function in Excel.	ЗН-5 УМ-4 УМ-5 К-2 АВ-1 АВ-3	Malanchuk
IW -16	Estimation of parameters of distribution of the investigated sign in Excel.	Interval estimation. Convidence intervals for point estimates.	ЗН-5 УМ-5 К-2 АВ-1	Oksana Malanchuk
IW -17	Estimation of random errors of measurements.	Estimation of random errors of direct measurements. Estimation of random errors of indirect measurements.	ЗН-5 УМ-5 К-2 АВ-1	Oksana Malanchuk
IW -18	Statistical testing of hypotheses in Excel.	Investigation of the influence of the factor on the displacement of the center of distribution of the feature in Excel.	ЗН-6 УМ-6 К-2 АВ-3	Oksana Malanchuk
IW -19	Checking the normality of the distribution in Excel.	Shapiro-Wilk's test.	ЗН-6 УМ-6 К-2 АВ-3	Oksana Malanchuk
IW -20	Checking statistical hypotheses about equality of parameters of distribution of two samples in Excel.	Testing the statistical hypothesis about the equality of variances of two normal sets. Testing the hypothesis of equality of distribution centers of two independent normal sets.	ЗН-6 УМ-6 К-2 АВ-3	Oksana Malanchuk
IW -21	Non-parametric method to estimate data in Excel (Mann-Whitney test).	Non-parametric method to estimate data in Excel (Mann-Whitney test). Comparison of particles by the Pearson xi-square method.	ЗН-6 УМ-6 К-2 АВ-3	Oksana Malanchuk
IW -22	Univariate analysis of variance in Excel.	One-factor analysis of variance for a parametric model. Tukey's method. Scheff's method.	ЗН-6 УМ-6 К-2 АВ-3	Oksana Malanchuk
IW -23	Modeling the linear dependence on factors in Excel.	Analysis of the significance of a linear correlation based on analysis of variance. Interval estimation of parameters of the model and the line of least squares.	ЗН-6 УМ-6 К-2 АВ-3	Oksana Malanchuk
IW -24	Curvilinear regression model.	Polynomial; exponential; logarithmic; hyperbolic.	ЗН-6 УМ-6 К-2 АВ-3	Oksana Malanchuk

The following *teaching methods are used during practical classes*: verbal methods (lecture, discussion); visual methods (illustration); practical methods (solving of problems with professional content); individual work of students with comprehension and learning of material; use of control and training computer software in the discipline; use of project method for interdisciplinary integration.

8. Verification of results

Current control is realized on the basis of the control of theoretical knowledge, skills and abilities. Forms of current control: oral survey (frontal, individual, combined survey), practical test of formed professional skills, test control (open and closed tests).

Individual work of students is evaluated on practical classes and is part of the final grade of the student. The final grade for the current educational activity is set on a 4-point (traditional) scale.

Criteria of evaluation

- ✓ grade 5/"excellent" – the student has mastered the theory flawlessly, demonstrates deep and comprehensive knowledge of the certain topic or academic discipline, the main theses of scientific papers and recommended literature, thinks logically and gives an answer, freely uses the acquired theoretical knowledge when analyzing practical material, expresses his attitude to certain problems, demonstrates a high level of mastery of practical skills;
- ✓ grade 4/"good" – the student has mastered the theoretical material well, knows the main aspects from primary sources and recommended literature, presents it in a reasoned way; has practical skills, expresses his thoughts on certain issues, but certain inaccuracies and errors are assumed in the logic of the presentation of theoretical content or in the performance of practical skills;
- ✓ grade 3/"satisfactory" – the student has basically mastered the theoretical knowledge of the topic or discipline, orients himself in primary sources and recommended literature, but answers unconvincingly, confuses concepts, additional questions cause the student uncertainty or lack of stable knowledge; when answering questions of a practical nature, reveals inaccuracies in knowledge, does not know how to evaluate facts and phenomena, relate them with future activities, makes mistakes when performing practical skills;
- ✓ grade 2/"unsatisfactory" – the student has not mastered the material of the topic (discipline), does not know scientific facts, definitions, hardly orients himself in primary sources and recommended literature, lacks scientific thinking, practical skills are not formed.

Code	**Code**	**Verification**	**Criteria**
ЗН-1 – ЗН-6, УМ-1 – УМ-6, К-1 – К-2 АВ-1 – АВ-3	L-1-7, PC-1-23, IW-1-24.	Test control on the MISA platform (10-15 test tasks with one correct answer); Oral survey and/or written control – theoretical questions (including questions on individual work) and tasks for solving	**Test control**: 50-69,99% – satisfactory; 70-89,99% – good; 90-100% – excellent. **Oral survey and/or written control:** evaluation according to evaluation criteria .

The final test		
General evaluation system	Scores of the current tests for semesters / exam – 60% / 40% in 200-points scale	
Scales	Traditional 4-point scale, 200-points scale, ECTS	
The conditions of access to the differential test	The student attended all practical (laboratory) classes and received at least 120 points for current educational activity.	
Type of a final examination	**Verification**	**Criteria**
Criteria of evaluation for the exam		
Exam	**Examination (exam)** is a form of final control of the student's mastery of theoretical and practical material on the academic discipline. The exam takes place in written form by examination papers in accordance with the academic program. The exam is written and includes both theoretical and practical training. **The structure of the examination papers**:	**Evaluation criteria for test tasks:** correct answer to one test - 1 point. **Evaluation criteria of theoretical questions:** **5 points –** the student sufficiently fully knows the educational material, explains it in a reasoned way, deeply and comprehensively reveals the content of theoretical questions; **4 points –** the student enough fully

	1) 40 standard test tasks, each of which has one correct answer out of five offered (format A). 40 minutes are allotted for writing the test. (40 points – 1 point for each test task); 2) two open descriptive questions (1 - 2 tasks, 10 points - 5 points for each question) and five problems for solving (3 - 7 tasks, 30 points - 6 points for each task). Duration – 95 minutes. In total - 80 points The list of exam questions is open throughout the entire course. **Maximum score points** which a student can score in exam is 80. **Minimum score points** required for passing is not less than 50	knows the educational material, explains it in a reasoned way, however permits insignificant inaccuracies during answering; **3 points –** the student does not answer the question fully enough, does not sufficiently justify his/her answer, the sequence of presentation of the material is incorrect, he/she makes mistakes in the use of conceptual apparatus or formulas; **2 points –** the student understands the material only in a general way, the answer is incomplete and shallow; the formulation is not correct enough; **1 point –** the student partially knows the educational material, does not reveal the content of the question, shows unsatisfactory knowledge of the conceptual apparatus; **0 points –** the student does not know the educational material and is not able to explain it, gives the wrong answer to the question or does not answer anything at all. **Evaluation criteria of solving problems:** **6 points** – the logically correct solution is given; all the key points of the solution are substantiated; correct answer is received; **5 points** – the logically correct sequence of the solution is given, all the key points of the solution are substantiated; 1–2 minor mistakes in calculations and transformations are possible, which do not affect the correctness of further solving; **4 points** – the logically correct solution is given; some of the key points of the solution are insufficient. 1–2 minor mistakes in calculations and transformations are possible, which do not affect the correctness of solution; the received answer may be incorrect or incomplete; **3 points** – the logically correct solution is given; some of the key points are insufficiently substantiated or not substantiated. 1–2 errors or typos in calculations or

		transformations are possible, which slightly affect the correctness of solutions; the received answer may be incorrect, or incomplete, or only a part of the task is solved correctly; **2 points** – some steps are omitted in the correct solution; the key points of the solution are not substantiated; errors in calculations or transformations that affect solution are possible; the received answer is incomplete or incorrect; **1 point** – there are only a few solution steps in the solution; the key points of the solution are not substantiated; the received answer is incorrect or the task is not completely solved; **0 points** – the sotution to the task is not started or the solution is completely incorrect.

The highest possible score points which a student can collect for the current educational activity for admission to the exam (pass-fail test) is 120 points.

Minimal number of score points which a student must collect for current educational activity for admission to the exam (pass-fail test) is 72 points.

Calculation of the points number is based on grades received by student by the traditional scale (by calculation of the arithmetic mean (AM) rounded to two decimal places). The resulting value is converted into points by multi-points scale as follows:

$$x = \frac{AM \times 120}{5}$$

For convenience, the table of recalculation on a 200-point scale is given:

Conversion of the average grade for current educational activity to the point scale for discipline which is finished with exam

4-grading scale	200-grading scale	4-grading scale	200-grading scale	4-grading scale	200-grading scale	4-grading scale	200-grading scale
5	120	4.45	107	3.91	94	3.37	81
4.95	119	4.41	106	3.87	93	3.33	80
4.91	118	4.37	105	3.83	92	3.29	79
4.87	117	4.33	104	3.79	91	3.25	78
4.83	116	4.29	103	3.74	90	3.2	77
4.79	115	4.25	102	3.7	89	3.16	76
4.75	114	4.2	101	3.66	88	3.12	75
4.7	113	4.16	100	3.62	87	3.08	74
4.66	112	4.12	99	3.58	86	3.04	73
4.62	111	4.08	98	3.54	85	3	72
4.58	110	4.04	97	3.49	84	Less than 3	Insufficiently
4.54	109	3.99	96	3.45	83		
4.5	108	3.95	95	3.41	82		

Grade on discipline is defined as the sum of points for current educational activity (at least 72 points) and points for the exam (at least 50 points).

Points on discipline are converted regardless both in ECTS scale and a 4-point scale. Scores of ECTS scale can not be converted into 4-point scale and vice versa. Scores of students taking into account the number of points on the discipline are ranked on a ECTS scale so that:

Grade in ECTS	Statistical index
A	Top 10% of students
B	The next 25% of students
C	The next 30% of students
D	The next 25% of students
E	The last 10% of students

Ranking with assigning grades of "A", "B", "C", "D", "E" is held for the students of one course, studying one specialty and successfully completed the academic discipline. Students who have received grades FX, F ("2") are not recorded to the list of students for ranking. Students who have received grade FX after repassing automatically get grade "E".

For students who completed the program successfully the points on discipline are converted into a traditional 4-point scale by absolute criteria, which are listed in the table below:

Points on discipline	Grade in 4-point scale
From170 to 200 points	**5**
From 140 to 169 points	**4**
From 122 to 139 points	**3**
Lower than minimum number of points that a student must score	**2**

9. Course policy

Student attendance is required.
The missed practical class are making up according to an appropriate schedule agreed on the department.
The policy of academic integrity.
Use any material or aid (including cell phone etc) during the period of test/exam is prohibited.

The policy of academic discipline is based on the principles of academic integrity. The student is obliged to fully master the knowledge, skills, practical skills and competencies of this discipline.
Policy on compliance with the principles of academic integrity of students of higher education:

- ✓ individual performance of educational tasks of current and final controls without using external sources of information, except for cases permitted by the teacher;
- ✓ cheating during control is prohibited (including using mobile devices).

Educational policy:

- ✓ attendance at all classes is mandatory for the purpose of current and final assessment of knowledge (except for respectable reason);
- ✓ missed classes are reworked according to the approved schedule;
- ✓ repass the topic for which the student received a negative grade is carried out at a time convenient for the teacher and the student;
- ✓ it is not allowed to repass the topic in order to impove the grade during the current and final control.

10. Books

***Main sources*:**

1. Edwin Jed Herman Calculus, Volume 1. University of Wisconsin-Stevens point Gilbert strang, Massachusetts institute of technology.- Openstax. -2016. – 875p. https://assets.openstax.org/oscms-prodcms/media/documents/Calculus_Volume_1_-_WEB_68M1Z5W.pdf
2. Craig A. Tracy Lectures on Differential Equations.- Department of Mathematics University of California Davis. – 2017.-165p. https://www.math.ucdavis.edu/~tracy/courses/math22B/22BBook.pdf

3. T.T.Soong Fundamentals of Probability and Statistics for engineers. John Wiley&Sons.-2021.- - https://www.junkybooks.com/book/reader.php?book=thebooks/6400f37bc4e6d-fundamentals-of-probability-and-statistics-for-engineers.pdf
4. Betty Kirkwood, Jonathan Sterne. Essential Medical Statistics. Blackwell Science, 2nd edition, 2003. – 512 p.
5. Marvin L. Bittinger, David J. Ellenbogen, Scott J. Surgent. Calculus and its applications. – Pearson, Cloth Bound with Access Card, 2014. – 984 p.
6. Chalyi A.V., Tsekhmister Ya.V., Agapov B.T. Medical and biological physics: textbook for the students of higher medical institutions of the IV accreditation level. – Vinnytsia, Nova Knyha, 2010. – 480 p.

Additional sources:

1. Chris McMullen. Essential Calculus Skills Practice Workbook with Full Solutions, Zishka Publishing, 2018. – 350p.
2. H. Motulsky. A Nonmathematical Guide to Statistical Thinking. Oxford University Press, USA; 3 edition, 2013. – 540 p.
3. E. Herman, G. Strang, Calculus. – OpenStax , 2018. – 873p.
4. P. Hoff Statistics. Lecture Notes. 2009. – 186p.

1.

11. Equipment, and software of the discipline / subject

- ✓ academic program of the discipline;
- ✓ lecture notes on discipline (thesis);
- ✓ lecture presentations;
- ✓ video content of lectures on the distance learning platform;
- ✓ guidelines for lecturers/instructors;
- ✓ guidelines for practical classes for students;
- ✓ guidelines for individual students' work;
- ✓ test and control tasks for practical classes;
- ✓ questions and tasks for the final control (exam).

12. Additional information

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