Київський національний університет
будівництва і архітектури
Кафедра ___вищої математики____

Шифр Спеціальності 193	Геодезія та землеустрій	Сторінка 1 з 3

«Затверджую»

Завідувач кафедри

_____ / Бондаренко Н.В. /

«__20__» __червня___2022_ р.

Розробник силабуса

_____ / Соколова Л.В. /

SYLLABUS

High mathematics. Special course

(educational component (discipline)

1) Code according to the educational program: __ОК3__
2) Academic year: __2022-2023__
3) Educational level: first level of higher education (bachelor's degree)
4) Education form: full-time
5) Field of knowledge: 19 Architecture and construction.
6) Speciality, educational program: "Geodesy and Land Management", "Geodesy".
8) Status of the educational component: selective
9) Semester: V
11) Teacher contact details: Sokolova Lyudmila Vitalyivna, PdD, associate professor, associate professor of the Department of Higher Mathematics sokolova.lv@knuba.edu.ua
12) Teaching language: English
13) Prerequisites (predecessor disciplines that must be graduated before this course): This discipline is offered to students who have graduated from higher mathematics, computer science, and engineering disciplines (geodesy, mapping, and land management).
14) Course Goal: Students must acquire a mastering the mathematical and computer skills in research, modelling, and numerical solving of applied engineering problems in geodesy. Using graph theory to optimize the sequence of planned works in geodesy. Attain knowledge of the map projections, probabilistic analysis of the reliability of technical equipment and statistical processing of the geodetic measurements to eliminate errors and determine the most probable values of these parameters.

15) Learning outcomes:

№	Program learning outcomes	Learning Effect Testing Method	form of study	Competency
1.	ПРН.01. Candidates should be able to analyze the statistical material obtained from geodetic measurements and recognize systemic and random errors to determine the statistical and functional relationship between sample data arrays of different measured values. Candidates should be able to analyze the possibility of the reliability of technical equipment. Candidates should be able to understand the mathematical features of map projection. Candidates should be able to apply the graph theory to optimize the sequence of planned work in geodesy.	Розрахунково-графічна робота	Daytime	К305 - demonstrate ability to choose an optimal decision; К308 – demonstrate analytical analysis ability; К315 – to be able to use educational and scientific literature; КСП02 – be a master in basic knowledge of related disciplines - physics, biology, mathematics, information technology, law, economics, etc.), and be able to use theories, principles and technical approaches outlined in the courses listed above.

16) Course structure:

Lectures, hours.	Practical lessons, hours	Laboratory lessons, hours	Course project / course work Settlement graphic work / Control work, hours	Independent work, hours	Final control form
20	18		1	52	3

Total number of hours:	90
Загальна кількість кредитів ECTS	3
An hours quantity (ECTS credits) of classroom training:	1,3

17) Course content: (separately for each form of training – Lectures/ Practical lessons / Calculation and graphic work)

Lectures:

Lecture 1. The concept of sets. Finite and infinite sets. Subsets. Algebra of sets. The cardinality of a set. Comparing sets. Continuous sets. Cantor's diagonalization method and its application.

Lecture 2. Definition of relation on sets. Classification and properties of binary relations (reflexive, antireflective, symmetric, antisymmetric, transitive) of sets. Equivalence relation and its properties. Equivalence classes. Factor-set. Examples of equivalence relations. Order relation. An ordered set. Partially ordered set. The concept of functional dependence as a binary relation.

Lecture 3. Elements of graph theory. A formal definition of a graph. Graphs and binary relations. Vertices and edges. An adjacency of vertices, the incidence of vertices and edges, and vertex degree. Oriented and undirected graphs. Distance between vertices. Graph. Tree. Forest. Basic properties of trees. Graph isomorphism.

Lecture 4. Basic concepts of probability theory. Basic principles of combinatorics. The concept of classical, statistical and geometric probabilities. Algebra of random events. Fundamental theorems of the probability theory, Bayes schemes and the formula of total probability. Bernoulli schemes, Poisson and Laplace asymptotic equations.

Lecture 5. Random values. Discrete and continuous random variables and their properties. The basic types of discrete random distributions, their properties and characteristics.

Lecture 6. Continuous random values and their properties. Basic types of continuous distributions. The exponential distribution and its relation to the theory of reliability. Normal distribution and its properties. Application and characteristics of the normal distribution. Distribution of errors of the geodetic measurements.

Lecture 7. Elements of mathematical statistics. Acquisition and registration of statistical data. Initial data processing. Concept of selective numerical characteristics. Statistical data ordering by means of the histogram.

Lecture 8. Two-dimensional random variables. Ordering of statistical data by means of a correlation table. Determination of sampled numerical characteristics of a two-dimensional random value. The concept of statistical dependence. Relation between two random variables. Correlation coefficient. The derivation of the linear regression equation using the least squares method.

Lecture 9. The concepts of topological, metric, and linear spaces. The concept of factor space. Infinite-dimensional Euclidean space. Hilbert space. Linear operators in Hilbert space. Projection operators. Basis in Hilbert space. Schwarz orthogonalization. Projections of a vector on a subspace.

Lecture 10. Definition of a projection. The concept of map projection. Classification of projections by curvature: conformal, equal-area, and arbitrary projections. Four types of curvature: the curvature of lengths, the curvature of angles, the curvature of areas, and the curvature of shapes. Gauss and Mercator projections.

Practical lessons:

Practical lesson 1. Performing exercises on operations with sets. The graphic representation of sets in the Cartesian system. Determination cardinality of a set. The finding of the equivalent of sets.

Practical lesson 2. Solving exercises concerned with finding the equivalence relations of sets. A finding of equivalence classes by a given relation. Finding a factor set by a given relation.

Practical lesson 3. A diagram of graph construction. Finding a graph vertex degree. Finding a path in a graph. A tree concept. Defining a route in a graph. Finding the minimum path using graphs. Relationship between graphs and binary relations.

Practical lesson 4. Basic schemes of probability theory, finding of the probabilities by classic formulas. Bayes, Bernoulli, Poisson and Laplace equations. Relation between some schemes of probability theory and graphs.

Practical lesson 5. Defining the random value type, its distribution and numerical characteristics. Estimation of the probability of random errors in geodetic measurement.

Practical lesson 6. Application of continuous distributions. Calculation of the reliability of technical devices. Calculation of numerical characteristics of continuous distributions. Practical application of the normal distribution to geodetic measurements.

Practical lesson 7. Primary processing of statistical tables. Calculation of sampled numerical characteristics. Analysis of geodetic measurement properties based on statistical data. The analysis of systematic and random errors in the statistical data acquired from the geodetic measurements.

Practical lesson 8. Determination of sampled numerical characteristics of a two-dimensional random value given by a correlation table. The finding of conventional numerical characteristics by the correlation table.

Practical lesson 9. A linear relationship between two random variables. Study of the correlation coefficient and correlation moment. The derivation of the linear regression equation using the least squares method.

Settlement graphic work:

The independent student work is supposed in the form of settlement graphic work.

The topic of the work – The initial analysis of statistical data. Elements of correlation theory. The derivation of the linear regression equation using the least squares method.

The goal of the work – organization of an analytical approach to solving specific engineering problems. Statistical analysis of geodetic measurements. The finding of statistical and functional dependence between different sample data.

18) Basic literature:

1. Levin O. Discrete Mathematics: An Open Introduction - 3rd Edition. – University of Northern Colorado, 2016.
2. Bondy J. A., Murty U. S. R. Graph theory with applications. – North-Holland, 1986.
3. Werner L. Probability Theory. A First Course in Probability Theory and Statistics - Walter de Gruyter GmbH, Berlin/Boston, 2016.
4. O'Leary M. L. A first course in mathematical logic and set theory. – John Wiley & Sons, Inc., 2016.
5. Bloch E. D. A First Course in Geometric Topology and Differential Geometry. – Birkhauser, 1997.

19) Additional literature sources:

1. Bluman A.G. Probability demystified. – McGraw-Hill, 2005.
2. Rumsay D. Probability for Dummies. – Wiley, 2006.

20) The system for assessment of educational achievements (points %):

Current assessment	**Settlement graphic work**	Total
ІПРН.01		
40	60	100

21) Conditions of admission to the final control: The candidate has successfully completed individual settlement-graphic work. The candidate was in all lessons.

22) Academic integrity policy: The candidate personally performed all individual tasks..

23) Link to the electronic educational and methodological complex of the discipline:
https://org2.knuba.edu.ua/course/view.php?id=420