# Silabus Selective Component SC

Name of the discipline:	Additional Aspects of Classical Mathematics				
Higher education level:	third (educational and professional)				
Moodle course page:	https://dl2022.khadi-kh.com/course/view.php?id=3261				
Scope of the sample component	4 credits (120 hours)				
Final control form	Credit				
Consultations:	on schedule				
Department name:	Department of higher mathematics				
Language of instruction:	English				
Course manager:	Yarkho Tetiana Oleksandrivna, Doctor of Pedagogical Sciences, Professor				
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# Additional Aspects of Classical Mathematics

**Summary of the educational component:** the purpose of studying the discipline in the system of continuous mathematical training of bachelors, masters and postgraduates is to form the mathematical competence of future doctors of philosophy, which is the basis of the fundamental component of their professional training.

**Subject of the discipline:** the study of classical set theory as the foundation of sections of classical mathematics; fuzzy set theory as a modern apparatus for formalizing uncertainties; special questions of linear algebra that form the basis of numerical optimization methods; additional topics of Integral Calculus; stability theory of solutions of differential equations as a practically significant topic of the theory of differential equations.

# The main objectives of the discipline are:

- study of basic concepts and facts of general set theory (classical and fuzzy);

- study of basic concepts and facts of special questions of linear algebra (linear spaces, linear maps);

- formation of skills of practical application of special questions of linear algebra to the study of properties of linear operators;

- familiarization with classical optimization methods, optimization problem;

- formation of the ability to study functions on the extremum;

- study of the theory of proper and non-proper integrals, depending on the parameter and its practical applications;

- introduction to the basics of Lyapunov stability theory;

- formation of research abilities for stability, asymptotic stability of rest points of systems of differential equations.

**Prerequisites for studying the educational component:** the course of the compulsory discipline "Higher Mathematics".

# Competencies that the applicant acquires:

### General competencies:

Ability to think abstractly, analyze and synthesize. Ability to conduct research at the appropriate level. Ability to search, process, and analyze information from various sources. Ability to generate new ideas (creativity). Ability to identify, pose, and solve problems. Ability to make informed decisions.

# Special (professional) competencies:

The ability to carry out original research, to achieve scientific results that create new knowledge and technologies in the field of Mechanical Engineering and related interdisciplinary areas and can be published in leading scientific publications in the field of Mechanical Engineering and related fields.

### Learning outcomes according to the educational program:

Formulate and test hypotheses; use appropriate evidence to substantiate conclusions, in particular, the results of theoretical analysis, experimental research and mathematical and/or computer modeling, and available literature data.

Develop and research conceptual, mathematical and computer models of processes and systems, effectively use them to gain new knowledge and/or create innovative products in the field of Mechanical Engineering and related interdisciplinary areas.

Plan and perform experimental and / or theoretical research using modern tools, critically analyze the results of your own research and the results of other researchers in the context of the entire complex of modern knowledge on the problem under study.

Ability and skills to identify contradictions and not solve problems or parts of them before, formulate working hypotheses, critically perceive and analyze ideas, look for their own ways to solve the problem, based on modern bibliographic and abstract databases, using, in particular, scientometric platforms, carry out critical analysis of their own research.

No	Topic name (I (C DR SP)		of hours		
JN≌	Topic name (LC, TK, SK)	Ochne	Zaochne		
	LC General set theory. Sets and their properties. Algebra of sets. The concept				
	of fuzzy sets.				
1	PR -	-	-		
	SR Function of belonging to a fuzzy set and methods for its construction.	18	18		
	I C Special questions of linear algebra. Linear (vector) spaces	2	2		
	DD On linear demondence and indemondence of visitors. Desig of a linear	2	2		
2	space.	2	2		
	SR Llinear subspaces.	6	6		
	LC Special questions of linear algebra Linear mappings	2	2		
	PR _				
3	SP Linear operators Figenvectors and eigenvalues of the linear operator. The				
	concept of quadratic forms.	12	12		
	LC Classical optimization methods. General statement of optimization	2			
	problems. The task of unconditional optimization.	2	2		
4	PR Solving problems for finding extremes.	2	2		
	SR Is the local, conditional, and global extrema of functions of two variables.				
	LCE LCE igenvalues that depend on the parameter. Steel and variable integration				
	limits.				
5	PR -	-	-		
5	SR Continuity Differentiability and integrability of eigenvalues that depend				
	on the parameter.	8	8		
	LC Is an independent parameter-dependent integral (of the first and second	2	2		
	kind).	2	2		
6	PR Finding eigenvalues and non-proper integrals that depend on the	2	2		
0	parameter and their derivatives.	2	2		
	SR Is a uniform convergence of integrals. Euler-Poisson Integral. Theme-	16	16		
	function. Gamma is a function.	10	10		
	LC Fundamentals of stability theory. Stability according to Lyapunov.	n	2		
7	Lyapunov's second method.	2	۷.		
/	PR -	-	-		
	SR Systems of ordinary differential equations. Lyapunov's theorem on	12	12		

#### Thematic plan

	asymptotic stability. Chetaev's instability theorem. Stability studies on the		
	first approximation.		
	LC The concept of First-Order partial differential equations. Basic definitions. Statement of the problem of integrating partial differential equations.	2	2
8	PR Research on the stability and asymptotic stability of rest points of systems of differential equations. Solving problems of proof with respect to solutions of partial differential equations.	2	2
	SR Properties of First-Order partial differential equations with one unknown function.	12	12
Togethe	LC	16	16
Togethe	PR	8	8
	SR	96	96

## **Training methods:**

\* lectures, practical exercises, explanations, etc.;

- \* standard calculation works;
- \* standardized tests;
- \* tasks for in-depth creative training;
- \* test papers;
- \* presentations of completed tasks and research;
- \* student presentations and presentations at scientific events;
- \* final comprehensive tests.

### **Evaluation system and requirements**

### **1** Current academic performance:

1.1 the current success of applicants for performing educational types of work in training sessions and for performing tasks of independent work is evaluated using a four-point Assessment Scale, followed by recalculation to a 100-point scale. When evaluating current academic performance, all types of work provided for in the curriculum are taken into account.

1.2 lectures are evaluated by determining the quality of performance of specified tasks.

1.3 practical exercises are evaluated by the quality of performing a control or individual task, performing and completing practical work.

1.4 assessment of the current academic performance of higher education applicants is carried out at each practical lesson (laboratory or seminar) on a four-point scale ("5", "4", "C", "2") and are entered in the academic performance log.

- "excellent": the applicant has perfectly mastered the theoretical material, demonstrates deep knowledge of the relevant topic or academic discipline, the main provisions;

- "good": the applicant has mastered the theoretical material well, has the main aspects from the original sources and the recommended literature of the RI, presents it in an argumentative manner; has practical skills, expresses his thoughts on certain problems, but admits certain inaccuracies and errors in the logic of presenting the theoretical content or when analyzing the practical one;

- "satisfactory": the applicant has mainly mastered the theoretical knowledge of the educational topic or discipline, is guided in the primary sources and recommended literature of the RI, but does not answer convincingly, confuses concepts, does not answer additional questions uncertainly, does not have stable knowledge; answering questions of a practical nature, shows inaccuracy in knowledge, does not know how to evaluate facts and phenomena, connect them with the future profession;

- "unsatisfactory": the applicant has not mastered the educational material of the topic (discipline), does not know scientific facts, definitions, almost does not navigate in primary sources and recommended literature, there is no scientific thinking, practical skills are not formed.

#### 2 Final assessment:

An applicant for Higher Education receives a credit in the last lesson in the discipline based on the results of the current assessment. The average score for current activities is converted to points on a 100-point scale.

Higher education applicants who have an average current grade in the discipline below "3" (60 points) can improve their current score in the last lesson by passing tests in the discipline.

Assessment of applicants ' Knowledge by testing is carried out on a scale of:

- "Excellent": the theoretical content of the course is fully mastered, without gaps, the necessary practical skills of working with the mastered material are formed, all the training tasks provided for in the training program are completed, the quality of their implementation is estimated by the number of points close to the maximum. (at least 90% of correct answers);

- "Very good": the theoretical content of the course is fully mastered, without gaps, the necessary practical skills of working with the mastered material are mostly formed, all the training tasks provided for in the training program are completed, the quality of most of them is estimated by the number of points close to the maximum. (82% to 89% of correct answers);

- "Good": the theoretical content of the course is fully mastered, without gaps, some practical skills of working with the mastered material are not sufficiently formed, all the training tasks provided for in the training program are completed, the quality of None of them is evaluated with a minimum number of points, some types of tasks are completed with errors (from 74% to 81% of correct answers);

- "Satisfactory": the theoretical content of the course is partially mastered, but the gaps are not significant, the necessary practical skills of working with the mastered material are mostly formed, most of the training tasks provided for in the training program are completed, some of the completed tasks may contain errors (from 67% to 73% of correct answers);

- "Satisfactory enough": the theoretical content of the course is partially mastered, but the gaps are not significant, the necessary practical skills of working with the mastered material are mostly formed, most of the training tasks provided for in the training program are completed, some of the completed tasks may contain errors (from 60% to 66% of correct answers);

- "Unsatisfactory": the theoretical content of the course is partially mastered, the necessary practical skills of work are not formed, most of the provided training programs for training tasks are not completed, or the quality of their performance is estimated by a number of points close to the minimum; with additional independent work on the course material, it is possible to improve the quality of performing educational tasks(with the possibility of re-passing)(less than 60% of correct answers);

- "Unacceptable" - the theoretical content of the course is not mastered, necessary

practical work skills are not formed, all completed training tasks contain gross errors, and additional independent work on the course material will not lead to any significant improvement in the quality of training tasks.(with a mandatory repeat course).

On a 100-point scale шкалою	on the national scale			
from 60 points to 100 points	are credited			
less than 60 points	are not credited			

#### Table1 - scale for transferring points to the National Assessment System

Table 2-correst	pondence of	<sup>2</sup> final rat	ing ratings	s in po	oints to	national	scale and	ECTS	scale ratings
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	Rating on the	Rating on the ECTS scale			
Rating	national scale (exam, credit)	Grade	Criteria		
90-100	Excellent	A	"Excellent" - the theoretical content of the course is fully mastered, without gaps, the necessary practical skills of working with the mastered material are formed, all the training tasks provided for in the training program are completed, the quality of their implementation is estimated by the number of points close to the maximum.		
82 - 89		В	"Good" - the theoretical content of the course is fully mastered, without gaps, the necessary practical skills of working with the mastered material are mostly formed, all the training tasks provided for in the training program are completed, the quality of most of them is estimated by the number of points close to the maximum.		
75 – 81	Good	С	"Good" - the theoretical content of the course is fully mastered, without gaps, some practical skills of working with the mastered material are not sufficiently formed, all the training tasks provided for in the training program are completed, the quality of performance of any of them is not evaluated with a minimum number of points, some types of tasks are performed with errors		

67 – 74	Satisfactory	D	"Satisfactory" - the theoretical content of the course is partially mastered, but the gaps are not significant, the necessary practical skills of working with the mastered material are mostly formed, most of the training tasks provided for in the training program are completed, some of the completed tasks may contain errors.
60 - 66		E	"Enough" - the theoretical content of the course is partially mastered, some practical work skills are not formed, many of the training tasks provided for in the training program are not completed, or the quality of performance of some of them is estimated by a number of points close to the minimum.
35 – 59	Unsatisfactory	FX	"Unsatisfactory" - the theoretical content of the course is partially mastered, the necessary practical skills of work are not formed, most of the provided training programs for educational tasks are not completed, or the quality of their performance is estimated by a number of points close to the minimum; with additional independent work on the course material, it is possible to improve the quality of performing educational tasks(with the possibility of re-passing)
1 – 34		F	"Unacceptable" -the theoretical content of the course is not mastered, the necessary practical skills are not formed, all completed training tasks contain gross errors, additional independent work on the course material will not lead to any significant improvement in the quality of training tasks.(with a mandatory repeat course)

## **Course policy:**

- the course involves working in a team, the environment in the classroom is friendly, creative, open to constructive criticism;

- mastering the discipline involves mandatory attendance at lectures and practical classes, as well as independent work;

- independent work involves the study of individual topics of the academic discipline, which are submitted in accordance with the program for independent study, or were considered briefly;

- all tasks provided for in the program must be completed on time;

- when studying the course, applicants for higher education must adhere to the rules of academic integrity set out in the following documents: "Rules of academic integrity of participants in the educational process of KHNADU (<u>https://www.khadi.kharkov.ua/fileadmin/P\_Standart/pologeniya/stvnz\_67\_01\_dobroch\_1.pdf</u>), "Moral and ethical code of participants in the educational process of KHNADU (<u>https://www.khadi.kharkov.ua/fileadmin/P\_Standart/pologeniya/stvnz\_67\_01\_MEK\_1.pdf</u>).

- cheating during test papers and tests is prohibited (including using mobile devices). Mobile devices can only be used during online testing.

### **Recommended literature:**

**1.** Балога С. Г. Дискретна математика :навчальний посібник. – Ужгород : ПП «АУПДОРШАРК», 2021. – 124 с.

2. Богданський Ю. В. Диференціальні рівняння : навчальний посібник / Ю. В. Богданський. – К.: ІВЦ, Вид-во «Політехніка», 2011. – 214 с.

3. Буланов Г. С. Функціональний аналіз: навчальний посібник / Г. С. Буланов, О. Г. Роженська, В. М. Астахов – Краматорск : ДДМА,2017. – 63 с.

4. Краєвський В. О. Спецкурс математичного аналізу «Диференціальні рівняння у частинних похідних та їх аналіз в системі MAPLE. Частина 1: навчальний посібник / В. О. Краєвський, Н. В. Саганюк – Кавецька. – Вінниця : ВНТУ, 2017. – 112 с.

5. Кривошея С. А. математичний аналіз : завдання для самостійної роботи студентів : навч.методичний посібник / С. А. Кривошея, Н. В. Майко, О. В. Маторна, П. М. Праценко. – К.: ВПЦ «Київський університет», 2015. – Ч.2. – 350 с.

6. Панасенко О. Б. Лекції з лінійної алгебри : електронний навчальний посібник / О. Б. Панасенко. – Вінниця, 2012. – 273 с. – Режим доступу : <u>http://amnm.vspu.edu.ua/ wp-content/ uploads/ 2016/10/</u> <u>Panasenko-linalg.pdf</u>

7. Ровенська О. Г. Вибрані питання курсу диференціальні рівняння / О. Г. Ровенська. – Краматорськ : ДДМА, 2017. 57 с.

8. Сікора Я. Б. Методи оптимізації та дослідження операцій / Я. Б. Сікора, А. Й. Щехорський, Б. Л. Якимчук. – Житимир: Вид-во ЖДУ ім. Івана Франка, 2019. – 148 с.

9. Ямпольський Л. С. Системи штучного інтелекту в плануванні, моделюванні та управлінні / Л. С. Ямпольський, Б. П. Ткач, О. I. Лісовиченко. – Київ : ДП Видавничий дім «Персонал», 2011. – 134 с. 10. Fuzzy Logic. Toolbox. User's Guide. The Math Works, Inc, 1999. - 134 p.

#### Additional sources:

1. distance learning course: https://dl2022.khadi-kh.com/course/view.php?id=3261

Developer (s)

syllabus of the academic discipline

Thelph thelph

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