Syllabus
VK Numerical methods

Subjects:	**Numerical Methods**
Level of higher education:	**first (undergraduate)**
Course page in Moodle:	*https://dl2022.khadi-kh.com/course/view.php?id=3616*
The scope of the educational component	**3 credits (90 hours)**
Final control form	**Test**
Consultations:	**on schedule**
Name of the department:	**Department of computer technologies and mechatronics**
Teaching language:	**English**
Course leader:	**Kozachok Larisa Mykolayivna, art. teacher**
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Brief content of the educational component:
the purpose
the study of the discipline "Numerical methods and mathematical methods of programming" is the formation of theoretical knowledge on the basics of numerical analysis and operations research, students' assimilation of basic numerical methods and the acquisition of skills in their application for solving mathematical problems that arise during the development of information systems. At the same time, much attention is paid to the practical work of students on personal computers using mathematical packages.
Subject:theoretical and methodological foundations, methodological provisions of scientific directions of research using information technologies, methods and hardware and software tools of computer and information technologies.
The main tasks of studying an academic discipline are:
 − substantiation and presentation of the unified theoretical and methodological foundations of numerical methods of mathematics;
 − formation and development of students' competencies and program learning outcomes in accordance with the educational and professional program "Software support of systems";
 −formation of directions for improvement and development of information technologies for research in software engineering;
 −formation of skills in the organization of independent research work and presentation of the results of scientific research.
Prerequisites for studying the educational component:
Higher mathematics, Physics, Basics of information technologies.

Competencies acquired by the acquirer:
*General competences***:**
 Ability to abstract thinking, analysis and synthesis;
 Ability to use information and communication technologies.

Special (professional) competences:
 Ability to identify, classify and formulate software requirements;

Ability to participate in software design, including modeling (formal description) of its structure, behavior and functioning processes;

Knowledge of data information models, ability to create software for data storage, extraction and processing.

Learning outcomes according to the educational program:

Know the main processes, phases and iterations of the software life cycle;

Know and apply professional standards and other legal documents in the field of software engineering;

Know and apply relevant mathematical concepts, methods of domain, system and object-oriented analyzes and mathematical modeling for software development.

Thematic plan

Topic No	Name of topics (LK, LR, PR, SZ, SR)	Number of hours	
		ocular	extram ural
1	LC The essence of numerical methods. General concepts. Characteristics of numerical methods.	2	
	PZ Resolution error. Rounding error during calculations on the computer.	2	
	SR Study of data types of computer mathematics systems.	8	
2	LK Numerical methods of solving nonlinear equations with one unknown.	2	
	PZ Method of dichotomy. Chord method. Newton's method. Simple iteration method.	2	
	SR Study of types of standard functions of computer mathematics systems.	8	
3	LK Direct and iterative methods of solving systems of linear algebraic equations.	2	
	PZ Statement of the problem. Gauss exclusion method. Gaussian method with selection of the main element.	2	
	SR Calculation of the inverse matrix.	7	
4	LK Direct and iterative methods of solving systems of linear algebraic equations	2	
	LU matrix decomposition software, Kholetskyi's method. Method of iterations. Gauss-Seidel method.	2	
	SR LU-decomposition of the matrix, Kholetsky's method.	7	
5	LK Numerical methods of solving systems of nonlinear equations	2	
	PZ Statement of the problem. Newton's method. Simple iteration method. The method of least squares.	2	
	SR Solution of systems of linear equations of large dimensions. Formulation of the problem. Types of sparse matrices.	7	
6	LK Numerical methods of approximation of functions. Approximation, interpolation and extrapolation.	2	
	PZ Method of least squares for approximation of functions. Interpolation is linear and quadratic. Lagrange interpolation polynomial. Newton's interpolating polynomial. Spline interpolation.	2	
	SR Numerical methods for calculating eigenvalues and eigenvectors of a matrix.	7	

7	LK Numerical differentiation of functions.	2	
	PZ Statement of the problem. Numerical differentiation formulas.	2	
	SR Numerical methods for calculating eigenvalues and eigenvectors of a matrix.	7	
8	LK Numerical integration of functions.	2	
	PZ Statement of the problem. Formula of trapezoids. Simpson's formula.	2	
	SR Implicit methods for solving hard Cauchy problems. Boundary value problems for ordinary differential equations.	7	
Toget her	LK	16	
	LR	16	
	SR	58	

Individual educational and research task(in the presence):

Teaching methods:
1) verbal: 1.1 traditional: lectures, explanations, stories, etc.;
1.2 interactive (non-traditional): problem lectures, discussions, etc.;
2) visual: method of illustrations, method of demonstrations
3) practical: 3.1 traditional: laboratory work;
3.2 interactive (non-traditional): business and role-playing games, trainings, brainstorming method.

Evaluation system and requirements:

Current performance
1The current success rate of applicants for the performance of educational types of work in training sessions and for the performance of independent work tasks is evaluated usingfour-pointrating scale with subsequent transfer to a 100-point scale. Current performance is taken into account during evaluationall types of work provided by the curriculumprogram
1.1 Lecture classes are evaluated by determining the quality of performance of specified tasks.
1.2 Practical classes are evaluated by the quality of performance of a control or individual task, performance and design of practical work.
1.3 Laboratory classes are evaluated by the quality of reports on the performance of laboratory work.
1.4 Seminar classes are evaluated by the quality of the performance of an individual task/abstract.
2Evaluation of the current success rate of higher education applicants is carried out at each practical session(laboratoryor seminary) on a four-point scale("5", "4", "Z", "2")and are enteredinaccounting journalacademicsuccess
–"excellent": acquirerflawlessly mastered the theoretical material, demonstrates deepknowledge ofrelevant topic or academic discipline, main provisions;
–"good": the applicant has mastered the theoretical material well, possesses the main aspects from primary sources and recommended literature, presents it in an argumentative manner; has practical skills, expresses his thoughts on certain problems, but certain inaccuracies and errors are assumed in the logic of the presentation of theoretical content or in the analysis of practical ones;
–"satisfactory": the applicant has basically mastered the theoretical knowledge of the educational topic or discipline, orients himself in primary sources and recommended literature, but answers unconvincingly, confuses concepts, answers additional questions

uncertainly, does not have stable knowledge; when answering questions of a practical nature, reveals 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(disciplines), does not know scientific facts, definitions, hardly orients himself in primary sources and recommended literature, lacks scientific thinking, practical skills are not formed.

3 Final score by current activity is recognized as an arithmetic average sum points for each lesson, for individual work, current control works by the formula:

$$K^{nomoч} = \frac{K1 + K2 + ... + Kn}{n},$$

where $K^{nomoч}$ –final assessment of success based on the results of current control;
$K1, K2, ..., Kn$ –performance evaluation n -th measure of current control;
n –number of ongoing control measures.

Assessments are converted into points according to the calculation scale (table 1).

Table 1 - Recalculation of the average grade for the current activity into a multi-point scale

4-point scale	100 points scale	4-ball scale	100 points scale	4-ball scale	100 points scale	4-ball scale	100 points scale
5	100	4.45	89	3.90	78	3.35	67
4.95	99	4.4	88	3.85	77	3.3	66
4.9	98	4.35	87	3.80	76	3.25	65
4.85	97	4.3	86	3.75	75	3.2	64
4.8	96	4.25	85	3.7	74	3.15	63
4.75	95	4.20	84	3.65	73	3.1	62
4.7	94	4.15	83	3.60	72	3.05	61
4.65	93	4.10	82	3.55	71	3	60
4.6	92	4.05	81	3.5	70	from 1.78 to 2.99	from 35 to 59
						reassembly	
4.55	91	4.00	80	3.45	69	from 0 to 1.77	from 0 to 34
4.5	90	3.95	79	3,4	68	repeated study	

Final assessment

1 A student of higher education receives a credit in the last lesson in the discipline based on the results of the current assessment. The average score for the current activity is converted into points on a 100-point scale, according to the conversion table (table 1).

Graduates of higher education education, who have an average current grade in the discipline lower than "3" (60 points), in the last session can increase their current grade by taking tests in the discipline.

Assessment of the knowledge of applicants through testing is carried out according to the following scale:

–"Excellent": at least 90% of correct answers;
–"Very good": 82% to 89% correct answers;
–"Good": from 74% to 81% of correct answers;
–"Satisfactory": from 67% to 73% of correct answers;
–"Fair enough": 60% to 66% correct answers;
–"Unsatisfactory": less than 60% of correct answers.

2The condition for obtaining credit is:

–making up for all missed classes;

–the average current grade in the discipline is not lower than "3" (60 points).

3For performing individual independent work and participating in scientific events, winners are awarded additional points.

3.1 Additional points are added to the sum of points scored by the student of higher education for the current educational activity (for disciplines, for which the final form of control is a test), or to the final grade in the discipline, for which the final form of control is an exam.

3.2 The number of additional points awarded for different types of individual tasks depends on their volume and importance:

–prizes in the discipline at the international / all-Ukrainian competition of scientific student works - 20 points;

–prize places in the discipline at the All-Ukrainian Olympiads - 20 points;

–participation in the international / all-Ukrainian competition of scientific student works - 15 points

–participation in international / all-Ukrainian scientific conferences of students and young scientists - 12 points;

–participation in all-Ukrainian Olympiads in the discipline - 10 points

–participation in olympiads and scientific conferences of the Khnadu in the discipline - 5 points;

–performance of individual scientific research (educational research) tasks of increased complexity- 5 points**.**

3.3 The number of additional points cannot exceed 20 points.

4The result of the study is evaluated (select is required):

–byby a two-point scale (passed/failed) according to table 2;

–on a 100-point scale (for differentiated assessment) according to table 3.

The final grade together with additional points cannot exceed 100 points.

Table 2 -The scale for transferring points to the national evaluation system

On a 100-point scale	On a national scale
from 60 points to 100 points	counted
less than 60 points	Not counted

Table 3–The scale for evaluating the knowledge of students based on the results of the final control of the academic discipline

Score in points	Evaluation on a national scale		Evaluation according to the ECTS scale	
	examination	test	Rating	Criteria
90-100	Perfectly	Enrolled	**A**	The theoretical content of the course has been mastered in its entirety, without gaps, the necessary practical skills for working with the mastered material have been formed, all educational tasks provided for in the training program have been completed, the quality of their performance has been assessed with a number of points close to the maximum

Score in points	Evaluation on a national scale		Evaluation according to the ECTS scale	
	examination	test	Rating	Criteria
80–89	Okay	Enrolled	**B**	The theoretical content of the course has been mastered in its entirety, without gaps, the necessary practical skills for working with the mastered material have mainly been formed, all educational tasks provided for by the training program have been completed, the quality of most of them has been assessed with a number of points close to the maximum
75-79			**WITH**	The theoretical content of the course has been mastered in its entirety, without gaps, some practical skills of working with the mastered material have not been formed enough, all educational tasks provided for by the training program have been completed, the quality of none of them has been assessed with a minimum number of points, some types of tasks have been completed with errors
67-74	Satisfactorily		**D**	The theoretical content of the course is partially mastered, but the gaps are not of a significant nature, the necessary practical skills for working with the mastered material are basically formed, most of the educational tasks provided by the training program have been completed, some of the completed tasks may contain errors
60–66			**E**	The theoretical content of the course has been partially mastered, some practical work skills have not been formed, many educational tasks provided by the training program have not been completed, or the quality of some of them has been assessed with a number of points close to the minimum.

Score in points	Evaluation on a national scale		Evaluation according to the ECTS scale	
	examination	test	Rating	Criteria
35–59	Unsatisfactorily	Not counted	**FX**	The theoretical content of the course has been partially mastered, the necessary practical work skills have not been formed, most of the prescribed training programs of educational tasks have not been completed, or the quality of their implementation has been assessed with a number of points close to the minimum; with additional independent work on the course material, it is possible to improve the quality of the performance of educational tasks (with the possibility of retaking)
0–34	Unacceptable		**F**	The theoretical content of the course has not been mastered, the necessary practical work skills have not been formed, all completed educational tasks contain gross errors, additional independent work on the course material will not lead to any significant improvement in the quality of the performance of educational 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 of lectures and laboratory classes, as well as independent work;
- independent work involves the study of individual topics of the academic discipline, which are presented in accordance with the program for independent study, or were considered briefly;
– all tasks provided by the program must be completed within the set time;
- if the student of higher education is absent from classes for a good reason, he presents the completed tasks during independent preparation and consultation of the teacher;
- while studying the course, students of higher education must adhere to the rules of academic integrity set forth in the following documents: "Rules of academic integrity of participants in the educational process of the Khnadu" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_dobroch_1.pdf), "Academic Integrity. Checking the text of academic, scientific and qualification papers for plagiarism" (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_85_1_01.pdf),
"Moral and ethical code of participants in the educational process of the National Academy of Sciences (https://www.khadi.kharkov.ua/fileadmin/P_Standart/pologeniya/stvnz_67_01_MEK_1.pdf)
- in case of detection of plagiarism, the applicant receives 0 points for the task and must repeat the tasks provided for in the syllabus;

- writing off during tests and exams is prohibited (including using mobile devices). Mobile devices are allowed to be used only during online testing.

Recommended literature: (literature no later than 10 years old, except for 1 fundamental classical textbook or monograph)

1 Greg Perry, Sanjay Hettyhewa. VisualBasic 6.: Trans. with English - Kyiv: JSC "BINOM Publishing House", 1999.

2 Porteous, M., Kirakowsky, J. & Corbett, M. (1993): SUMI user handbook, Human Factors Research Group, University College Cork.

3 Arms, William Y. (2000): Digital libraries, Cambridge, Massachusetts, MIT Press.

4 Computer technology and programming: Textbook / V.M. Sydorenko.: KDEU, 2015.

5 Informatics: Computer technology. Computer Technology. Manual under the editorship O.I. Pushkarya - K.: Publishing center "Akademiya", 2018.

Additional sources:

1. distance course:
https://dl.khadi.kharkov.ua/course/view.php?id=2570
2.https://www.mathworks.com
3.https://www.visualstudio.com

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