Ministry of Science and Higher Education of the Republic of Kazakhstan

D.Serikbayev EKTU

APPROVED:
Dean of ISoE:
Rakhmetullina Z.T.
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COMPUTER MATHEMATICS
Syllabus

Programme of Study: 7M05401 Mathematics

Course code: KM6302

Number of credits: 6
Cycle: PD
Component: UC

Ust-Kamenogorsk, 2024

The syllabus was developed at «ISoE» on the basis of the State General Educational Standard for Higher Education approved by the Minister for Education and Science of the Republic of Kazakhstan (Order No. 604 dated 10.31.2018), Rules for organizing educational process based on academic credit system approved by the Minister for Education and Science of the Republic of Kazakhstan (Order No. 563 dated 12.10.2018), Education Program, Work Curriculum, and the Catalog of Elective Courses.

Approved by the Quality Assurance Commission

Chairperson Date 29.08.2024 y. minutes №1	Mukhamedova R.O.
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1 COURSE DESCRIPTION. ITS PLACE IN THE ACADEMIC PROCESS

1.1 Course Overview

Studies a set of theoretical, algorithmic, hardware and software tools designed to effectively solve all types of mathematical problems on computers with a high degree of visualization of all stages of calculations. Problems of computational geometry on the plane and in space, construction of a convex hull, Voronoi diagrams and Delaunay triangulation are considered.

1.2 Goals and Objectives of the Course

Goals of the course:

Formation of knowledge on computer mathematics systems – new tools that automate the execution of both numerical and analytical calculations.

Objectives of the course:

- students acquire knowledge in the field of theory and history of computer technology development;

-acquire skills in working in environments of modern commonly used operating systems,

-master modern methods and techniques for searching and using information through the capabilities of the global computer network;

-development of the ability to organize educational and research work using modern numerical and symbolic mathematical packages;

-acquisition of the ability to independently expand computer mathematical knowledge with their further use in the analysis of mathematical models of a wide range of applied tasks.

1.3 Цели устойчивого развития

Goal 3. Ensure healthy lives and promote well-being for all at all ages

Goal 4. Ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all

Goal 13. Take urgent action to combat climate change and its impacts

1.4 Learning Outcomes

Learning outcomes are determined based on Dublin Descriptors for the appropriate educational level and are expressed through competencies.

Core competencies to be formed	Learning outcomes (units of core competencies)	
	Programme of study	Course
KK3 - Willingness to master mathematics as a universal language of science, a means of modeling phenomena and processes;	PO5 - To compare mathematical knowledge and methods in the construction of mathematical models to improve the effectiveness of management decisions;	- Knowledge and understanding of theoretical, algorithmic, hardware and software tools designed to effectively solve all types of mathematical problems on computers with a high degree of visualization of all stages of calculations. - To set new scientific tasks in the field of mathematics; to apply modern
	PO6 - Apply high-tech mathematical apparatus and application software packages to solve applied problems in the field of physics, chemistry, biology, economics, medicine, ecology;	

Core competencies to be formed	Learning outcomes (units of core competencies)	
	Programme of study	Course
		mathematical methods in solving various problems of science and technology. - Plan, develop, implement and coordinate the process of scientific research; critically analyze, evaluate and compare new ideas, draw reasoned conclusions, make your own judgments; constantly update professional knowledge, independently learn new knowledge. - Conduct theoretical and applied scientific research in the field of mathematics; international cooperation in the field of mathematics and its applications. - The ability to set and solve applied tasks using modern information and communication technologies.

1.5 Educational Technologies Used in the Course

1.5.1 Modern Educational Technologies

The following educational technologies are used during the training:

- During the training sessions, the use of the following educational technologies is provided: - Information and communication technology; - Technology for the development of critical thinking; - Design technology; - - Integrated learning technology; - - Technologies of level differentiation; - Group technologies; - Traditional technologies (lectures, laboratory classes).

1.5.2 Adaptive Learning Technologies (Inclusive Education)

The following Learner-adaptive educational technologies can be used in education for persons with special needs:

- To successfully master the discipline, the following adaptive educational technologies can be used in teaching people with disabilities: - encouraging students' interest in analyzing their own social skills; - direct training in social skills; - explanation and modeling of the application of social skills.

1.6 Prerequisites

- Analysis, number theory and approximation

1.7 Postrequisites

1.8 Course Workload

Types of classes	hours
Lectures	30
Practical classes	30
SAWTG (Student Autonomous Work under Teacher Guidance)	30
SAW (Student autonomous work)	90

Types of classes	hours
Final assessment method	Exam

2 COURSE CONTENT

2.1 Course Topics

№	Topic, content	Workload (hours)	Достигаемые результаты CDIO	Метод обучения	Reading
	Lectures				
1	**Topic 1. Computer mathematics and mathematical packages.**	2	Basic knowledge of mathematics and natural sciences Modeling	Blended learning method and traditional learning method	1-7
2	**Topic 2. Variables, basic operators, and operations.**	2	Basic knowledge of mathematics and natural sciences Modeling	Blended learning method and traditional learning method	1-7
3	**Topic 3. Arrays.**	2	Basic knowledge of mathematics and natural sciences Modeling	Blended learning method and traditional learning method	1-7
4	**Topic 4. Graphs.**	4	Basic knowledge of mathematics and natural sciences Modeling	Blended learning method and traditional learning method	1-7
5	**Topic 5. Symbolic calculations in Mathcad documents.**	2	Basic knowledge of mathematics and natural sciences Modeling	Blended learning method and traditional learning method	1-7
6	**Topic 6. The sum of operators, products, differentiation and integration.**	2	Basic knowledge of mathematics and natural sciences Modeling	Blended learning method and traditional learning method	1-7
7	**Topic 7. Solving nonlinear equations and systems of equations in the MathCAD package.**	4	Basic knowledge of mathematics and natural sciences Modeling	Blended learning method and traditional learning method	1-7

№	Topic, content	Workload (hours)	Достигаемые результаты CDIO	Метод обучения	Reading
8	**Topic 8. Solving optimization problems in the MathCAD package.**	4	Basic knowledge of mathematics and natural sciences Modeling Evaluation and qualitative analysis	Blended learning method and traditional learning method	1-7
9	**Topic 9. Experimental data processing.**	2	Basic knowledge of mathematics and natural sciences Modeling	Blended learning method and traditional learning method	1-7
10	**Topic 10. Programming without modules in the MathCAD package.**	2	Basic knowledge of mathematics and natural sciences Modeling	Blended learning method and traditional learning method	1-7
11	**Topic 11. Programming a module in the MathCAD package.**	2	Basic knowledge of mathematics and natural sciences Problem statement and formulation	Blended learning method and traditional learning method	1-7
12	**Topic 12. Analytical calculations.**	2	Basic knowledge of mathematics and natural sciences Modeling	Blended learning method and traditional learning method	1-7
TOTAL				**30**	
	Practical classes				
1	**Topic 1. Computer mathematics and mathematical packages.**	2	Evaluation and qualitative analysis	Blended learning method and traditional learning method	1-7
2	**Topic 2. Variables, basic operators, and operations.**	2	Evaluation and qualitative analysis	Blended learning method and traditional learning method	1-7
3	**Topic 3. Arrays.**	2	Evaluation and qualitative analysis	Blended learning method and traditional	1-7

№	Topic, content	Workload (hours)	Достигаемые результаты CDIO	Метод обучения	Reading
				learning method	
4	**Topic 4. Graphs.**	4	Evaluation and qualitative analysis	Blended learning method and traditional learning method	1-7
5	**Topic 5. Symbolic calculations in Mathcad documents.**	2	Evaluation and qualitative analysis	Blended learning method and traditional learning method	1-7
6	**Topic 6. The sum of operators, products, differentiation and integration.**	2	Evaluation and qualitative analysis	Blended learning method and traditional learning method	1-7
7	**Topic 7. Solving nonlinear equations and systems of equations in the MathCAD package.**	4	Evaluation and qualitative analysis	Blended learning method and traditional learning method	1-7
8	**Topic 8. Solving optimization problems in the MathCAD package.**	4	Evaluation and qualitative analysis	Blended learning method and traditional learning method	1-7
9	**Topic 9. Experimental data processing.** Experimental data processing.	2	Evaluation and qualitative analysis	Blended learning method and traditional learning method	1-7
10	**Topic 10. Programming without modules in the MathCAD package.**	2	Evaluation and qualitative analysis	Blended learning method and traditional learning method	1-7
11	**Topic 11. Programming a module in the MathCAD package.**	2	Evaluation and qualitative analysis	Blended learning method and traditional learning method	1-7
12	**Topic 12. Analytical calculations.**	2	-	Blended learning method and	1-7

№	Topic, content	Workload (hours)	Достигаемые результаты CDIO	Метод обучения	Reading
				traditional learning method	
TOTAL				**30**	

2.2 Tasks for Student Autonomous Work (SAW)

Topic	Content	Assessment method	Submission date, week	Workload (hours)	Результаты CDIO
The most simple operations. Vectors and matrices. Functions that work with The Matrix.	Operations (commands)that allow you to perform mathematical operations.	Job protection, verbal inquiry	3	20	Solutions and recommendations
Construct function graphs construct. Analysis of functions by their graphical representation.	Determining the basic properties of a function, and therefore the properties of a specific process that models it.	Job protection, verbal inquiry	7	20	Basic knowledge of mathematics and natural sciences
Solving a system of linear algebraic equations. Solving nonlinear equations.	Through the program Kramer, the Gauss method, solving the inverse Matrix and transcendent equations and a system of nonlinear multivariate equations.	Job protection, verbal inquiry	11	25	Basic knowledge of mathematics and natural sciences
Differentiation and integration. Statistical processing of data in the system.	The problem of approximate calculation of the values of functions in the intervals between nodal points and beyond. This problem is solved by approximating the initial dependence, that is, replacing it with an approximate and easily computable one.	Job protection, verbal inquiry	14	25	Basic knowledge of mathematics and natural sciences
TOTAL				**90**	

2.3 Schedule of Course Task Submission

Types of tasks	Academic period, week														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Knowledge															
Practical work No. 1		+													
Practical work No. 2				+											
Practical work No. 3					+										
Practical work No. 4						+									
Practical work No. 5								+							
Practical work No. 6										+					
Practical work No. 7											+				
Practical work No. 8												+			
Practical work No. 9													+		
Practical work No. 10														+	
Comprehension															
Practical work No. 1		+													
Practical work No. 2				+											
Practical work No. 3					+										
Practical work No. 4						+									
Practical work No. 5								+							
Practical work No. 6										+					
Practical work No. 7											+				
Practical work No. 8												+			
Practical work No. 9													+		
Practical work No. 10														+	
Application															
Practical work No. 1		+													
Practical work No. 2				+											
Practical work No. 3					+										
Practical work No. 4						+									
Practical work No. 5								+							
Practical work No. 6										+					
Practical work No. 7											+				
Practical work No. 8												+			
Practical work No. 9													+		
Practical work No. 10														+	
Analysis															
Practical work No. 1		+													
Practical work No. 2				+											
Practical work No. 3					+										
Practical work No. 4						+									
Practical work No. 5								+							

Types of tasks	Academic period, week														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Practical work No. 6										+					
Practical work No. 7											+				
Practical work No. 8												+			
Practical work No. 9													+		
Practical work No. 10														+	

3 ASSESSMENT OF STUDENT KNOWLEDGE

Teacher oversees various tasks related to ongoing assessment and determines students' current performance twice during each academic period. Ratings 1 and 2 are formulated based on the outcomes of this ongoing assessment. The student's learning achievements are assessed using a 100-point scale, and the final grades P1 and P2 are calculated as the average of their ongoing performance evaluations. The teacher evaluates the student's work throughout the academic period in alignment with the assignment submission schedule for the discipline. The assessment system may incorporate a mix of written and oral, group and individual formats.

Period	Type of work	Final Assessment
First rating	Practical work No. 1	0-100
	Practical work No. 2	
	Practical work No. 3	
	Practical work No. 4	
	Practical work No. 5	
Second rating	Practical work No. 6	0-100
	Practical work No. 7	
	Practical work No. 8	
	Practical work No. 9	
	Practical work No. 10	
Final control	Exam	0-100

3.1 The evaluating policy of learning outcomes by work type

Type of work	**90-100**	**70-89**	**50-69**	**0-49**
	Excellent	**Good**	**Satisfactory**	**Unsatisfactory**

The student’s final grade in the course is calculated on a 100 point grading scale, it includes:
- 60% of current academic performance results;
- 40% of the result obtained on the exam.

The final grade is calculated by the formula:

$$И = 0{,}6\frac{P_1+P_2}{2} + 0{,}4Э \quad (1)$$

where P1, P2 are numerical values of Rating 1 and Rating 2 correspondingly;
Э is the numerical value of the examination grade.

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Alphabetical grade	Numerical value	Points (%)	Traditional grade
A	4.0	95-100	Excellent
A-	3.67	90-94	
B+	3.33	85-89	Good
B	3.0	80-84	
B-	2.67	75-79	
C+	2.33	70-74	
C	2.0	65-69	Satisfactory
C-	1.67	60-64	
D+	1.33	55-59	
D	1.0	50-54	
FX	0.5	25-49	Unsatisfactory
F	0	0-24	

4 COURSE POLICY

Student is required to:
-attendance of lectures and practical classes according to the schedule is mandatory;
-the presence of students in classes is checked at the beginning of classes. In case of lateness, the student must silently enter the classroom and get involved in the work, and during the break explain to the teacher the reason for being late;
-two lateness to classes is equivalent to one skipping class;
-the works evaluated in points should be submitted on time. The number of points is reduced for late delivery of works. Students who have not passed all the tasks are not allowed to take the exam;
-repeated passing of the boundary control by the student, in case of receiving an unsatisfactory grade, is not allowed;
-students who have received an average rating of Rsr = (P1 + P2)/ 2 less than 50% are not allowed to take the exam; -mobile phones must be turned off during classes;
-the student must come to classes in business clothes.

5 RECOMMENDED READING

5.1 Key reading

1. Плещинская И.Е., Гитов А.Н., Бадертдинова Е.Р., Дуев С.И. Интерактивные системы Scilab, Matlab, Mathcad. Учебное пособие (книга). Казанский национальный исследовательский технологический университет, 2014 г.
2. Ю.Воскобойников, В.Очков. Программирование и решение задач в пакете Mathcad. Новосибирск: НГАСУ, 2002.

3. Дьяконов В.П. MATLAB. Полный самоучитель. Издательство: ДМК Пресс. ISBN 978-5-94074-652-2; 2010 г. 768 стр.

4. СмоленцевН.К. Введениев MATLAB. Учебное пособие для студентов ВУЗов. Кемерово, 2010.

5. Бабенкова Т.В. Математическое моделирование с использованием пакета Mathcad. Ч. 1: Задачи линейной алгебры: Учеб. пособие / М.В. Жигалов, Т.В. Бабенкова. – Саратов: Сарат. гос. техн. ун-т, 2009.

6. Макаров Е.Г. Mathcad: Учебный курс. – СПб.: Питер, 2009.

7. В.Ф. Очков, Е.П. Богомолова, Д.А. Иванов. Физико-математические этюды с Mathcad и Интернет, 2016. - 388 с.

5.2 Further reading

1. Очков В. Ф., Богомолова Е. П., Иванов Д. А. Физико-математические этюды с Mathcad и Интернет: Учебное пособие. — СПб.: Издательство «Лань», 2016. — 388 с.:

2. С.П. Семенов, В.В. Славский, П.Б. Татаринцев. Системы компьютерной математики. Учебное пособие для студентов математического факультета АГУ/ Барнаул:. Изд-во Алт. ун-та, 2004.– 128 с

3. IPR SMART http://www.iprbookshop.ru

4. ScienceDirect - http://www.sciencedirect.com.

5. EBSCO Discovery Service (EDS) - http://search.ebscohost.com