COMPUTER MATHEMATICS (PART 1)

COURSE SYLLABUS

Code and name of specialty	121 Software Engineering	**Institute / faculty**	Faculty of Computer Science and Software Engineering
Program name	“Software Engineering”	**Department**	Software Engineering and Management Information Technologies
Type of program	Educational and Professional	**Language of instruction**	Ukrainian, English

LECTURER

Name, E-mail	Nataliia Stratiienko, Nataliia.Stratiienko@khpi.edu.ua

Ph.D., Associate Professor, Professor of the Department of Software Engineering and Management Information Technologies, NTU «KhPI». Prepared and published more than 60 research papers, training manuals and textbooks (1 training manual recommended by the Ministry of Education and Science of Ukraine, 1 training manual recommended by the Academic Council of NTU "KhPI", 3 articles in publications indexed in Scopus) (Google Scholar: https://scholar.google.com/citations?user=9cw0zwgAAAAJ&hl=ru; ORCID: https://orcid.org/0000-0002-7925-6687; Scopus: https://www.scopus.com/authid/detail.uri?authorId=57196007565).

Leading lecturer of courses: *Fundamentals of the Theory of Algorithms, Algorithms and Data Structures, Computer Mathematics, Fundamentals of Project Management, Formation and Development of IT Project Teams (in Ukrainian and English)*

GENERAL DESCRIPTION OF THE COURSE

Summary	The course "Computer mathematics (part 1)” is a course in the cycle of professional compulsory training of the specialty 121 “Software Engineering”. It is taught in the third semester in the amount of 150 hours (5 ECTS credits), in particular: lectures – 48 hours, laboratory classes – 16 hours, self-study work – 86 hours. The course includes two modules and two modular tests. The study of the discipline ends with the test.
Course objectives	The objective of the discipline "Computer mathematics (part 1)" is the formation of a modern system of views in the field of computer mathematics among students, the acquisition of practical skills in the use of formal methods and models of computer mathematics in information processing and description of processes associated with software development
Types of classes and control	Lectures, workshops, self-study work (and individual calculation work). Final assessment – test.
Term	3

Student workload (credits) / Type of course	5 / Mandatory	**Lectures (hours)**	48	**Workshops (hours)**	16	**Self-study (hours)**	86

Program competences	GC 01. Ability to abstract thinking, analysis and synthesis. GC 05. Ability to learn and master modern knowledge.

	GC 06. Ability to search, process and analyze information from various sources. PC26. Ability to algorithmic and logical thinking.

Learning outcomes	Teaching and learning methods	Forms of assessment (continuous assessment CAS, final assessment FAS)
PO01. Analyze, purposefully search for and select the necessary information and reference resources and knowledge to solve professional problems, taking into account modern advances in science and technology.	Interactive lectures with presentations, discussions, workshops, teamwork, case method, feedback method from students, problem learning	Written individual assignments for workshops (CAS), assessment of knowledge in workshops (CAS), express - survey(CAS), online tests (CAS), final / semester control in the form of a semester test, in accordance with the schedule of the educational process (FAS)
PO05. Know and apply relevant mathematical concepts, methods of domain, system and object-oriented analysis and mathematical modelling for software development.	Interactive lectures with presentations, discussions, workshops, teamwork, case method, feedback method from students, problem learning	Written individual assignments for workshops (CAS), assessment of knowledge in workshops (CAS), express - survey(CAS), online tests (CAS), final / semester control in the form of a semester test, in accordance with the schedule of the educational process (FAS)
PO18. Know and be able to apply information technology processing, storage and transmission of data.	Interactive lectures with presentations, discussions, workshops, teamwork, case method, feedback method from students, problem learning	Written individual assignments for workshops (CAS), assessment of knowledge in workshops (CAS), express - survey(CAS), online tests (CAS), final / semester control in the form of a semester test, in accordance with the schedule of the educational process (FAS)

ASSESSMENT AND GRADING

Ranges of poin corresponding grades	Total score (points) all types of learnir activities	ECTS grading scale	The national grading scale	Allocation of grade points	
	90-100	A	excellent		**100% Final assessment** as a result of Final test (30%) and Continuous assessment (70%). **30% Final test** **70% Continuous assessment**: Workshops (20%) Calculation work (20%) Two module tests (30%)
	82-89	B	good		
	74-81	C			
	64-73	D	satisfactory		
	60-63	E			
	35-59	FX	Unsatisfactory (with the exam retak option)		
	0-34	F	Unsatisfactory (with mandatory repetition of the course)		

Course policy	Students are required to attend classes as scheduled and comply with ethical conduct. If absent, students will need to complete all tasks to compensate for the missed classes. Participation in workshops requires preliminary preparation and advance processing of all the necessary materials for productive discussions during the session. Written assignments must be submitted on time.

COURSE STRUCTURE AND CONTENT						
Topic 1	Introduction to Operations Research	**Workshop 1**	Mathematical models and methodology for operations research. Construction of mathematical models.	Самостійна робота	Individual calculation work.	
Topic 2	Notation and geometric interpretation of LP problems	**Workshop 2**	Bases plans for linear programming problems and their properties. Solving LP problems based on the base plan existence theorem		Studying the course topics with the help of recommended reading, homework	
Topic 3	Bases plans for linear programming problems and their properties	**Workshop 3**	Finite methods for solving LP problems. Simplex method			
Topic 4	The first algorithm of simplex method	**Workshop 4**	Artificial basis method and M- method.			
Topic 5	The second algorithm of the simplex method, or the inverse matrix method	**Workshop 5**	Elements of duality theory in linear programming.			
Topic 6	The artificial basis method	**Workshop 6**	Integer linear programming. Gomori method.			
Topic 7	The M-method for LP problems	**Workshop 7**	Branch and bound method.			
Topic 8	Post-optimization analysis in linear programming	**Workshop 8**	Transportation tasks. Northwest corner method. Potential method.			
Topic 9	General properties of integer programming problems					
Topic 10	Methods for solving integer programming problems					
Topic 11	Transportation tasks. Determination of the initial basis plan					
Topic 12	Transportation tasks. Potential method					
Topic 13	General properties of nonlinear programming problems					

Topic 14	Numerical methods of one-dimensional unconstrained optimization					
Topic 15	Numerical methods of the 0th order					
Topic 16	Numerical Analysis of the 1st order					
Topic 17	Numerical Analysis of 2nd order					
Topic 18	Conditional optimization					

RECOMMENDED READING

Compulsory

1.Hamdy A. Taha. (2017). Operations Research: An I Introduction (10th Global Edition). Pearson.

2. Годлевский, М. Д., Лисицкий, В. Л., Стратиенко, Н. К. (2016). Исследование операций: решение задач и варианты типовых расчетов: учеб. пособие для студентов направления подгот. "Компьютерные науки". Харьков : НТУ"ХПИ".

3. Wayne L. Winston. (2021). Operations Research: Applications and Algorithms. (4th ed.). Cham: Springer Nature Switzerland AG.

4.Глушик, М. М., Телесницька, Н. М. (2020). Дослідження операцій. Львів: “Новий світ.

5. Гужва, В. О., Стратієнко, Н. К., Бородіна, І. О. (2018). Методичні вказівки до виконання лабораторних робіт з курсу “Дослідження операцій”: [Електронний ресурс]: для студ., які навчаються за спец. 121 “Інженерія програмного забезпечення” та 122 “Комп’ютерні науки”. Харків: НТУ “ХПІ”.

6. Лисенко, О.І., Алєксєєва, І.В. (2016). Дослідження операцій: конспект лекцій. КИЇВ: НТУУ «КПИ».

7. John Vince. (2020). Foundation Mathematics for Computer Science: A Visual Approach. (2nd ed.). Springer.

8. Frederick S Hillier, Gerald J Lieberman. (2021). Introduction to operations research. (Eleventh ed.). New York, NY: McGraw-Hill EducG.

Recommended

9. Jun Wu. (2018). The Beauty of Mathematics in Computer Science. Chapman & Hall.

10. Малярець, Л. М., Лебедєва, І. Л., Норік, Л. О. (2017). Дослідження операцій та методи оптимізації: [Електронний ресурс]: практикум у 2-х ч. Ч. 1.. Харків: ХНЕУ ім. С. Кузнеця.

11.Математичні методи дослідження операцій: підручник. (2017). Суми: Сумський державний університет.

12.Кузьмичов, А. І. (2017). Оптимізаційні методи і моделі. Моделювання засобами MS Excel: навчальний посібник. Київ: Видавництвово Ліра-К.

13. Андруник, В. А., Висоцька, В. А., Пасічник, В. В., Чирун, Л. Б., Чирун, Л.В. (2020). Чисельні методи в комп‘ютерних науках: навчальний посібник. Львів: Видавництво «Новий світ–2000».

14. Eric Lehman, F. Thomson Leighton, Albert R. Meyer. (2017). Mathematics for Computer Science. 12th Media Services.

Academic integrity

Graduate students are expected to adhere to the Code of Ethics of Academic Relations and Integrity” of NTU “KhPI”.

The content of this syllabus is consistent with the course program.