M091	Applied Math for Computer Science	L	S	P	ECTS
		4	0	E	9

Course objectives. The main objective of the course is to introduce mathematical areas that are widely used in computer science. During lectures, students are expected to understand selected topics in four areas: combinatorics, probability, number theory and multivariable calculus. During exercises students solve problems that require applying previously acquired knowledge.

Course prerequisites. Calculus I. Calculus II. Linear algebra I. Linear algebra II.

Syllabus.

1. **Introduction.** Sums. Recurrences. Multiple Sums. Integer Functions. Floors and Ceilings. Applications of integer functions.
2. **Number Theory.** Divisibility. Euclidean Algorithm. Prime numbers and fundamental theorem of arithmetic. Congruencies. Chinese Reminder Theorem. Euler theorem. Application of congruencies. Quadratic Residues. Legendre and Jacobi symbols.
3. **Combinatorics.** The fundamental counting principles. Permutations and combinations of (multi)sets. Binomial and multinomial coefficients. Partitions of numbers and sets. Linear recurrences with constant coefficients. Systems of recurrences. Recurrence relations with two indices. Inclusion-exclusion principle. Generating functions. Applications of generating functions in solving recurrences. Special generating functions. Convolutions. Exponential generating functions. Special numbers.
4. **Probability.** Random experiment. Definition and examples of probability. Conditional probability (definition, independence of events, law of total probability). Discrete random variable (definition, distribution table, numeric characteristics and interpretations, binomial distribution, Poisson distribution.) Continuous random variable (definition, density function, distribution function, numeric characteristics, normal distribution).
5. **Multivariable Calculus.** Real multivariable functions. SpaceR^n. Level curves and level surfaces. Limit and continuity. Partial derivatives and differentiability of multivariable functions. Gradient. Geometric interpretation: equation of tangential plane and normal on surface. Partial derivatives of higher order. Partial derivatives of implicit functions and compound. Directional derivative. Vector functions. Differentiability of vector multivariable function. Jacobi matrix. Differentials of higher order. Applications of differential calculus of multivariable functions: mean value theorems, extremes and conditional extremes. Multiple integrals. Double integral on rectangle: notion, properties, Fubini theorem. Double integral on general domains: definition, computation. Change of variables theorem, polar coordinates. Applications of double integral. Triple integral: computation, cylindrical and spherical coordinates, applications.

EXPECTED LEARNING OUTCOMES

No.	LEARNING OUTCOMES
1.	To apply basic properties of divisibility, Euclidean algorithm and factorization of natural numbers.
2.	To apply modular arithmetic and Euler theorem, solve linear congruencies and system of congruencies.
3.	To apply basic combinatorial rules of enumeration.
4.	To apply rules for permutations and combinations of (multi)sets in problems.
5.	To apply and solve recursive relations.
6.	To apply probability, conditional probability, random variable and its properties.
7.	To apply differential calculus in finding the tangential plane and normal on surface, and optimization problems of finding local extrema of multivariable functions.
8.	To recognize conditions for applying typical probabilistic distributions in problems.
9.	To recognize and explain fundamental terms in differential and integral calculus of real vector multivariable functions, like continuity, limit, partial derivative, differential of function and multiple integral.
10.	To distinguish random from deterministic experiment.
11.	To calculate Legendre and Jacobi symbols.
12.	To calculate and interpret numerical characteristics of discrete random variables.
13.	To calculate partial derivatives of composition of elementary functions, implicit and parametric functions.
14.	To calculate area and volume by using multiple integrals.

COUPLING OF THE EXPECTED LEARNING OUTCOMES, TEACHING PROCESS ORGANIZATION AND THE EVALUATION OF THE TEACHING OUTCOMES

TEACHING PROCESS ORGANIZATION	ECTS	LEARNING OUTCOMES **	STUDENT ACTIVITY *	EVALUATION METHOD	SCORE	
					min	max
Lecture attendance	2	1-5	Class attendance, discussion, solving the problems individually and in a team	Lists with signatures, observing the activity during the lectures	0	10
Repeated exam	3	1-5	Solving the problems individually	Grading	22	40
Final exam	4	1-5	Revising	Oral exam	28	50
TOTAL	9				50	100

Teaching methods and student assessment. Lectures and exercises are obligatory. During the semester, students can take written examinations. Satisfactory scores on examinations can replace the final written examination. After lectures and exercises finish, student take final written and oral examinations.

Can the course be taught in English: Yes

Basic literature:

1. D. Veljan, Kombinatorna i diskretna matematika, Algoritam, Zagreb, 2001.
2. I. Matić, Uvod u teoriju brojeva, Sveučilište Josipa Jurja Strossmayera u Osijeku - Odjel za matematiku, Osijek, 2015.
3. M. Benšić, N. Šuvak, Uvod u vjerojatnost i statistiku, Odjel za matematiku, Osijek, 2013.
4. J. Stewart, Calculus 7th Edition, McMaster University and University of Toronto, Brooks/Cole, Cengage Learning, Belmont, 2008.

Recommended literature:

1. R. L. Graham, D. E. Knuth, O. Patashnik, Concrete Mathematics: A Foundation for Computer Science, 2nd edition, Addison-Wesley Publishing Company, 1994.
2. N. Elezović, Vjerojatnost i statistika - Diskretna vjerojatnost, Element, Zagreb, 2007.
3. N. Elezović, Vjerojatnost i statistika – Slučajne varijable, Element, Zagreb, 2007.
4. S. Kurepa, Matematička analiza 3: Funkcije više varijabli, Tehnička knjiga, Zagreb, 1984.
5. Š. Ungar, Matematička analiza u Rn, Golden marketing-Tehnička knjiga, Zagreb, 2005.
6. B.P. Demidovič, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke, Tehnička knjiga, Zagreb, 1986.