COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mathematical Analysis I [S1SI1E>ANA1]

Course

Field of study
Artificial Intelligence

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

The knowledge from the area of high school mathematics. The abilities of solving some problems of calculus and linear algebra. Awareness of the necessity to improve the knowledge and expertise, readiness to undertake a cooperation in the team.

Course objective

The goal of the subject is to attain the knowledge from the area of the selected topics in calculus I and to get the skills that allow to apply the obtained knowledge to analize the mathematical problems.

Course-related learning outcomes

Knowledge:
Knows and understands in an advanced level selected facts, objects and phenomena, as well as methods and theories explaining the complex relations between them, constituting extended knowledge of mathematics [K1st_W1]

Skills:
Is able to work individually and in a team; is able to plan and organize work – both individually and in a

team; is able to estimate the time needed to complete a task; is able to develop and implement a work schedule ensuring that deadlines are met. The graduate is able to determine and use models of the selected mathematical problems as well as to use them for the analysis and design of computer science [K1st_U3]

Social competences:
Is ready to critically evaluate received knowledge and content. Is ready to recognize the importance of knowledge and to consult experts in solving the problem [K1st_K2]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Lecture:
- grading knowledge and abilities showed in an written exam
Exercises:
- testing knowledge and preparation to exercises,
- awarding practical knowledge obtained during the previous exercies and lectures,
- grading knowledge and abilities related with calculations,
- test for exercises and/or written elaboration (that can be made partially outside of exercises)

Programme content

1. FUNCTION OF ONE VARIABLE AND THEIR PROPERTIES
Functions (definition, domain, range) and their graphs. Properties of functions (monotone, bounded, periodic, even, odd). Three special functions (absolute-value, signum and entier function). Operations on functions (composition of functions, inverse function).
2. CLASSICAL FUNCTIONS
Exponential and logarithmic functions. The natural logarithm. Trigonometric functions and inverse trygonometric functions (the arc functions). Hyperbolic functions.
3. SEQUENCES OF REAL NUMBERS
Definition of a sequence, bounded and monotone sequences, limits of sequences. Properties of convergent sequences (uniqueness, theorem on three sequences, monotone property, algebraic properties), number e.
4. LIMIT OF A FUNCTION AND CONTINUITY
Limits of functions. Properties of limits. One-sided limits, limits at infinity. Continuous functions. Properties of continuous functions (Weierstrass theorem and Darboux Theorem).
5. THE DERIVATIVE AND DIFFERENTIABLE FUNCTIONS
The derivative. Geometrical interpretation of the derivative (tangent line to the curve). Differentiation rules. The chain rule. Derivatives of inverse functions. Derivatives of exponential and logarithmic functions. Derivatives of trigonometric functions and their inverses. Implicit differentiation. Higher-order derivatives. The Mean-Value Theorem and its consequences (monotonicity of f = sign of its derivative f"). Indeterminate forms of limits and de l"Hospital rule. Taylor formula and Maclaurin formula. Critical points and extreme values (local and global extreme points, monotonicity of a function, points of inflection, convexity and concavits). Asymptotes and graphs of functions.
6. INDEFINITE INTEGRALS
Antiderivatives (primitive functions). Integration of classical functions (exponential, logarithmic, trigonometric). The method of substitution. Integration by parts. The method of partial fractions. Inverse substitutions.

Course topics

I. Functions of one variable and their properties: I1. Functions (definition, domain, range) and their graphs. Properties of functions (monotone, bounded, periodic, even, odd). Three special functions (absolute-value, signum and entier function). I2. Operations on functions (composition of functions, inverse function). II. Classical functions: IIa. Exponential and logarithmic functions. The natural logarithm. Trigonometric functions. IIb. Trigonometric functions and inverse trigonometric functions (=the arc functions). Hyperbolic functions.
III. Sequences of real numbers: IIIa. Limits of sequences. Properties of convergent sequences. IIIb. Bounded and monotone sequences, number e. IV. Limit of a function and continuity: IVa. Limits of

functions. Properties of limits. One-sided limits, infinite limits, and limits at infinity. IVb. Continuous functions. Properties of continuous functions (Weierstrass theorem and Darboux property). V. The derivative and differentiable functions: Va. The Derivative. Geometrical interpretation of the derivative (tangent line to the curve). Differentiation rules. The chain rule. Derivatives of inverse functions. Vb. Derivatives of exponential and logarithmic functions. Derivatives of trigonometric functions and their inverses. Implicit differentiation. Higher-order derivatives. Vc. The mean-value theorem and its consequences (monotonicity of f = sign of its derivative f'. Indeterminate forms of limits and de l'Hospital rule. VI. Applications of differentiation: VIa. Taylor formula and Maclaurin formula. VIb. Critical points and extreme values (local and global extreme points, monotonicity of a function. VIc. Points of inflection, convexity and concavity). VII. Asymptotes and sketching the graph of a function. VIII. Optimization problems.

Teaching methods

Lectures – the lecture is organized with the multimedia presentations and complemeted with many examples, showing an application of the presented issues.
Exercises – discussing open problems, comprehensive analysis for selected problems in mathematics, initiation open discussion devoted to methods which might be used to solve problems related to selected topis in mathematics, grading homeworks.

Bibliography

Basic
R. A. Adams and C. Essex, "Calculus. A Complete Course", 9th Edition, 2018.
Additional
James Stewart; Calculus: Early Transcendentals, 6th Edition; Thomson Higher Education, Belmont, CA, 2008.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	62	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	63	2,50