COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mathematical Analysis [S1Cybez1>AM]

Course

Field of study
Cybersecurity

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

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

dr Agnieszka Ziemkowska-Siwek
agnieszka.ziemkowska@put.poznan.pl

Lecturers

Prerequisites

Basic mathematical knowledge from secondary school. Student is able to meet the challenges arising from the high school. Student has a ability to think logically. Student is aware of the need to expand their competences. He understands the need for learning

Course objective

To provide students with basic knowledge of mathematical analysis in the field of real functions of one and many variables, differential and integral calculus, as well as sequences, infinite series and power series. To develop problem-solving skills using mathematical analysis tools.

Course-related learning outcomes

Knowledge:
1. The student knows the concepts of limit of the sequence and the function, continuity of the function, derivative and it applications, convergence or divergence of the series.[K1_W001]
2. The student knows the concept of integrals and knows methods of calculation and applications.[K1_W001]
3. The student has knowledge of partial derivatives, to be able calculate extrema for functions of two

variables and implicit function.[K1_W001]
4. The student has knowledge of Taylor and Maclaurin series.[K1_W001]

Skills:
1. The student can define functions and he is able to describe their properties. He can evaluate limits of sequences and functions. Moreover, the student can apply theorems and methods of calculus in optimization problems. He is able to find the extrema and analyse of functions in order to construct the graph of them.[K1_U05]
2. The student can calculate indefinite, definite and improper integrals, measures of areas, the length of curves, volumes and surface areas of solids of revolution.[K1_U05]
3. Student is able to determine convergence or divergence of series.[K1_U05]
4. Student is able find a power series representation of the function and determine it convergence.[K1_U05]

Social competences:
1. Student is aware of the level of their knowledge in relation to research in exact and technical sciences.[K1_K01]
2. Student is aware of the deepening and expansion of knowledge to solve newly created technical problems.[K1_K02]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture - written exam during session
Tutorials - two long test + activity during classes, which can earn up to 10% bonus points.
Assessment criteria:
below 50% - 2,0 50%-59% - 3,0 60%-69% - 3,5
70%-79% - 4,0 80%-89% - 4,5 90%-100% - 5,0
The course completion rules will be communicated to students at the beginning of the semester through the university’s electronic systems and during the first class meeting (in each form of classes).

Programme content

Sequences. Differential and integral calculus of functions of one variable. Infinite series and power series. Selected problems of differential calculus of functions of several variables.

Course topics

1. Sequences (Definition of sequences. Monotonicity, boundedness and limits of sequences. Theorem about the uniqueness of a limit. Arithmetics of proper and improper limits. The theorem about three sequences. Definition of Euler's constant.)
2. Functions of one real variable (Definition of a function. Domain and range of functions. Monotonicity of functions. Odd and even functions. Periodicity. Compound functions.Inverse functions. Review of elementary functions - polynomials, power functions,exponential functions, logarithmic functions, trigonometric ones, the inverse trigonometric functions (arcus) - formulas, graphs, properties.)
3. Limits of functions. (Limits of the functions at a point.Arithmetics of proper limits. One-handed limits. Improper limits. Asymptotes of the graphs of functions. Continuity of functions.)
4. Derivative of function (Definition of the derivative at a point. Geometric interpretation. Equations for a tangent line and a normal line. Rules for differentiation. Mean value theorems and their applicastions.Extrema of functions - global and local. Criteria for existing such extrema. Higher order derivatives. Taylor's theorem.Expansions of e^x, sinx, cosx functions into Maclaurin's series. Concavity. Points of inflection. Indeterminate forms. De l’Hospital's theorem.
5. Indefinite integrals (Antiderivative of a function, indefinite integrals. Integrals of elementary functions. Integration by parts and integration by substitution. Integration of rational functions. Integration of trigonometric functions (universal substitution). Integration of some irrational functions (methods ofvariation of parameters).)
6. Definite anf improper integrals (Definition of definite integrals. Relations between indefinite and definite integrals. Integration by parts and integration by substitution for definite integrals. Geometric interpretation of definite integrals. Applications of definite integrals (areas, volumes of solids, arches length etc). Improper integrals.)

7. Infinite series and power series (Definition of infinite series, sum of the series, necessary condition for convergence, convergent or divergent infinite series. Convergence tests (integral test, comparison test, alternating series test, ratio test, root test). Absolute and conditional convergence Power series, radius of convergence, interval of convergence. Power series representations of functions. Taylor and Maclaurin series and applications.)
8. Differential calculus of functions of two variables (Domain of functions. Partial derivatives. Differentials of functions - some applications. Local extrema of functions of two variables.)
Tutorials:
Solving practical tasks using the material presented in the lecture

Teaching methods

1. Lecture: lecture conducted on the blackboard or mulimedia presentation accompanied with examples presented on the blackboard
2. Tutorials: solving problems on the board, initiating discassion about the solutions

Bibliography

Basic:
1. M. Gewert, Z. Skoczylas, Analiza Matematyczna 1 i 2, Definicje, twierdzenia i wzory, Oficyna Wydawnicza GiS, Wrocław 2019.
2. W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach cz. I i II, Wydawnictwo Naukowe PWN, Warszawa 2015.
3. M. Gewert, Z. Skoczylas, Analiza Matematyczna 1 i 2, Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2018.
4. W. Żakowski, G. Decewicz, Matematyka cz. I, Analiza matematyczna, WNT, Warszawa 2017.
5. W. Żakowski, W. Kołodziej, Matematyka cz. II, Analiza matematyczna, WNT, Warszawa 2017.

Additional:
1. H. J. Musielakowie, Analiza matematyczna tom 1 i 2, Wydawnictwo Naukowe UAM, Poznań 1993.

Breakdown of average student's workload

	Hours	ECTS
Total workload	130	5,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	70	2,50