SUBJECT CARD	
Name of subject in Polish	**ANALIZA MATEMATYCZNA 2A**
Name of subject in English	**MATHEMATICAL ANALYSIS 2A**
Profile:	**academic**
Level and form of studies:	**1st level, full-time**
Kind of subject:	**obligatory**
Group of courses:	**NO**

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	**30**	**30**			
Number of hours of total student workload (CNPS)	**100**	**75**			
Form of crediting	Examination	crediting with grade*			
For group of courses mark (X) final course					
Number of ECTS points	**4**	**3**			
including number of ECTS points for practical classes (P)		**3**			
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	**1,5**	**1,5**			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

Student must have basic knowledge in one-variable differential and integral calculus, confirmed by completing the Mathematical Analysis 1A, 1B course with a positive grade or other course covering single variable differentia and integral calculus

SUBJECT OBJECTIVES

C1. Exposition of the basic convergence tests for series and properties of power series.
C2. Exposition of the basic concepts and theorems of multivariate calculus.
C3. Exposition of the concept of a double integral, methods of its calculation and applications.
C4. Exposition of the basic concepts of ordinary differential equations and their solving methods based on the Laplace transform techniques.

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:
PEU_W01 knowledge of the basic criteria for the convergence of numerical series and properties of power series,
PEU_W02 knowledge of basic concepts and theorems of differential calculus of functions of many variables,
PEU_W03 knowledge of methods for calculating double integrals,
PEU_W04 knowledge of the Laplace transform.

Relating to skills
PEU_U01 ability to verify of convergence of infinite series and to expand a function into a power series using expansions of elementary functions,
PEU_U02 the ability to calculate partial and directional derivatives and the gradient of functions of many variables and the ability to interpret the obtained quantities, ability to solve optimization problems for functions two variables,
PEU_U03 ability to calculate double integrals and use them to calculate areas, volume and selected physical quantities,
PEU_U04 ability to use the Laplace transform to solve linear differential equations of the first and second order.

Relating to social competences
PEU_K01 understanding the need for systematic and independent work on mastery of course material.

PROGRAMME CONTENT

	Lecture	**Number of hours**
Lec 1	**Improper integrals of type I.** Comparison and limit comparison test. Examples of applications of improper integrals.	2
Lec 2	**Infinite series.** The basic criteria for convergence of series. Absolute and conditional convergence. The alternating series test (Leibniz's theorem).	4
Lec 3	**Power series.** The radius and interval of convergence. Cauchy-Hadamard theorem. Taylor and Maclaurin series.	2
Lec 4	**Differential calculus of functions of two (many) variables.** Sets in the plane and in space. Functions of two (many) variables. Graphs of typical functions of two variables. Surfaces of revolution and cylindrical surfaces. Definition and geometric interpretation of a first order partial derivative. The tangent plane to the graph of two-variable function. The differential. Directional derivatives. Gradient of a function Higher order partial derivatives. Schwarz's Theorem. Local extrema of two-variable function. Necessary and sufficient conditions for the existence of minimum /maximum. Conditional extremes of two-variable functions. The smallest and the largest value of a function on a closed region. Examples of optimization problems	10
Lec 5	**Double integrals.** Definition of a double integral. Geometric and physical interpretation. Properties of double integrals. Methods of calculation of double integrals over normal regions. Double integrals in polar coordinates. Applications of double integrals.	6
Lec 6	**Introduction to differential equations and Laplace transform.** Basic definitions for differential equations of the first and second order. Differential equations with separable variables. Linear differential equations of the first order. Definition and properties of the Laplace transform. Laplace transforms of basic functions. Application of the Laplace transform to solving linear differential equations of the first and second order.	6
	Total hours	**30**

Classes		Number of hours
Cl 1	**Improper integrals of type I.** Calculation of improper integrals, verification of convergence, examples of applications.	2
Cl 2	**Infinite series.** Verification of convergence of infinite series.	2
Cl 3	**Power series.** Computation of the radius and interval of convergence of a power series. Finding power series of functions using expansions of basic functions.	4
Cl 4	**Differential calculus of functions of two (many) variables**. Finding the domain. Sketching level curves and the graphs of cylindrical surfaces and surfaces of revolution. Calculation of partial derivatives. Finding the tangent plane equation. Using the differential to estimate the accuracy of calculations. Determination and interpretation of the gradient of a function and the directional derivative. Determination of local and conditional extremes of functions of two variables. Determining the smallest and largest value of a function on a closed region. Examples of optimization problems.	9
Cl 5	**Double integrals.** Reduction of a double integral to an iterated integral. Change of order of integration. Calculation of double integrals over normal regions. Double integrals in polar coordinates. Examples of applications of double integrals.	6
Cl 6	**Introduction to differential equations and Laplace transform.** Solving differential equations with separable variables and linear equations of the first order. Determination of Laplace transforms and originals based on given formulas. Application of the Laplace transform to solving linear differential equations of the first and second order.	5
Cl 6	**Test.**	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Lecture - traditional method.
N2. Classes - traditional method (problems sessions and discussion).
N3. Student's self-study with the assistance of mathematical packages.
N4. Tutorial.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F, P - Cl	PEU_U1-PEK_U4 PEU_K1	Tests, oral presentations, quizzes
P - Lec	PEU_W1-PEU_W4	exam

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] M. Gewert, Z. Skoczylas, Analiza Matematyczna 2. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2016.
[2] M. Gewert, Z. Skoczylas, Analiza Matematyczna 2. Przykłady i Zadania, Oficyna Wydawnicza GiS, Wrocław 2016.

[3] R. Leitner, Zarys Matematyki Wyższej dla Studiów Technicznych, Cz. 1 - 2 WNT, Warszawa, 2006.

SECONDARY LITERATURE:

[1] W. Krysicki, L. Włodarski, Analiza Matematyczna w Zadaniach, Cz. II, PWN, Warszawa 2006.
[2] F. Leja, Rachunek Różniczkowy i Całkowy, Wydawnictwo Naukowe PWN, 2012.
[3] M.Zakrzewski, Markowe wykłady z matematyki. Analiza, geometria i świat fizyczny, Oficyna Wydawnicza GiS, Wrocław 2017.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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