

FACULTY OF CIVIL ENGINEERING

SUBJECT CARD

Name in English: Mathematics – selected topics
Name in Polish: Matematyka – wybrane zagadnienia
Main field of study (if applicable): *Civil Engineering*
Specialization (if applicable): Civil Engineering
Level and form of studies: ~~1st~~ 2nd level*, full-time / ~~part-time~~*
Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~*
Subject code: CEB007261
Group of courses: ~~YES~~ / NO*

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	15	15			
Number of hours of total student workload (CNPS)	60	30			
Form of crediting	Examination / crediting with grade *	Examination / crediting with grade *	Examination=/crediting with grade *	Examination / crediting with grade *	Examination=/crediting with grade *
For group of courses mark (X) final course					
Number of ECTS points	2	1			
including number of ECTS points for practical (P) classes		0,9			
including number of ECTS points for direct teacher-student contact (BK) classes	0,6	0,6			

* delete as appropriate

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. The student has knowledge of mathematical analysis in the following areas: basic concepts of topology, differential and integral calculus of functions of one variable, differential and integral calculus of functions of several variables.
2. Knows the basic types of ordinary differential equations and elementary methods of integration. From the first order equations - equation with separated variables, homogeneous equations, linear equations, Bernoulli equation. With a range of higher order differential equations - the theory of linear equations. Knows the basic methods of solving systems of ordinary differential equations - elimination method and the method of Euler.
3. Knows the basic concepts, theorems and methods of linear algebra, algebra of polynomials and analytic geometry.

SUBJECT OBJECTIVES

- C1. To familiarize students with the most common partial differential equations of second order used in mechanics.
- C2. The acquisition by students of elementary methods of solving partial differential equations.
- C3. Acquisition of intuition about the relationship of mathematically formulated boundary

	value problems with problems solved in structural mechanics.
C4.	To familiarize students with contemporary, based on the theorems of functional analysis, methods of formulation and solving boundary value problems.
C5.	To familiarize students with the mathematical foundations of the finite element method.

SUBJECT EDUCATIONAL EFFECTS	
Relating to knowledge:	
PEK_W01	gain knowledge in the basics of the theory of partial differential equations
PEK_W02	recognize elements of contemporary mathematical analysis
PEK_W03	gaining knowledge about modern methods of solving boundary value problems
Relating to skills:	
PEK_U01	properly distinguish between types of equations and boundary value problems
PEK_U02	has the ability to bring to a canonical form of linear equations of order 2, can use a Fourier method, correctly distinguishes between types of equations and boundary value problems
PEK_U03	gaining basic skills in differentiation distribution
PEK_U04	gaining basic skills in the formulation and numerical solution of complex boundary problems
Relating to social competences:	
PEK_K01	can work to resolve the tasks independently and in a team (participation in discussions on auditorium exercises in analyzing problems reported by other students)
PEK_K02	learn to think logically, clearly formulate issues and to resolve them within a specific theory and the specific assumptions

PROGRAMME CONTENT		
Form of classes - lecture		Number of hours
Lec1	Motto: "We will not talk unnecessary things" (Stanislaw Ignacy Witkiewicz Shoemakers) <u>Basic concepts:</u> guide to the basic concepts of topological conventions signs, basic definitions, classification - linear equations, half-linear quasi-linear examples.	1
Lec2	<u>Linear partial differential equations of second order on the plane</u> Classification, characteristic equation, performance, bringing hyperbolic, parabolic and elliptical to a canonical form.	2
Lec3	<u>The d'Alembert and Fourier</u> solution of the equation string by d'Alembert method, solution of the equation strings and heat flow equation Fourier method (separation of variables).	2
Lec4	<u>Laplace equation</u> physics issues leading to the Laplace equation, harmonic functions, removing the fundamental solution, maximum principle, uniqueness of solutions.	2
Lec5	<u>Normed spaces</u> linear spaces, normed metric spaces, functional spaces, Banach space, unitary space, Hilbert space, the Pythagorean theorem, theorem on orthogonal projection.	2

Lec6	<u>Sobolev spaces</u> compactly supported functions, linear functionals, distribution, distribution derivatives, Sobolev space, spatial properties of H^1 .	2
Lec7	<u>Generalized solutions of elliptic equations II row</u> Weak formulation of boundary value problems, Lax-Milgram theorem, application of Lax-Milgram theorem.	2
Lec8	<u>Methods of variational equations</u> The method of least squares orthogonal projection method, Galerkin method, Ritz method.	2
Total hours		15

Form of classes - class		Number of hours
Cl1	Solving problems of the simplest methods of integration of partial differential equations	1
Cl2	Imports of second order linear equations to canonical form	2
Cl3	Imports of second order linear equations to canonical form Solving boundary value problems by the method of separation of variables	2
Cl4	Solving the boundary problems containing the Laplace equation	2
Cl5	Solving the problems relating to properties of normed spaces	2
Cl6	Solving the problems relating to properties of Sobolev space	2
Cl7	Solving problems concerning the application of Lax-Milgram theorem (proof uniqueness of solutions). Solving problems using Galerkin and Ritz methods.	2
Cl8	Solving problems using Galerkin and Ritz methods. Colloquium (45 minutes)	2
Total hours		15

Form of classes - laboratory		Number of hours
Lab1		
...		
Total hours		

Form of classes - project		Number of hours
Proj1		
...		
Total hours		

Form of classes - seminar		Number of hours
Sem1		
...		
Total hours		

TEACHING TOOLS USED	
N1. Lecture: traditional form - definitions, theorems and proofs in all written on the blackboard.	
N2. Lectures and exercises: longer examples presented theorems and methods.	
N3. Classes: Discussion within a group of students of different abilities to solve problems.	

N4. Prepared lists and tasks on the website [2] for independent solution and opportunities for presentation and discussion exercises. The complete solution will be served at exercises, and some posted on the [2].

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Educational effect number	Way of evaluating educational effect achievement
F1 (classes)	PEK_W01 PEK_W02 PEK_W03 PEK_U01 PEK_U02 PEK_U03 PEK_U04 PEK_K01 PEK_K02	assess the activities of students in solving problems formulated at the list of tasks
P1 (classes)	PEK_W01 PEK_W02 PEK_W03 PEK_U01 PEK_U02 PEK_U03 PEK_U04 PEK_K02	final assessment on the basis of the final test (45 minutes), including assessments for the activity
P2 (lecture)	PEK_W01 PEK_W02 PEK_W03 PEK_U01 PEK_U02 PEK_U03 PEK_U04 PEK_K02	Final Exam - tasks to solve

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] 1. R.V. Churchill, J.W. Brown, Fourier Series and Boundary Value Problems, McGraw-Hill Book Company, New York 1978.

[2] <http://www.ib.pwr.wroc.pl/wpula>

SECONDARY LITERATURE:

[1] W. Puła, Mathematics. A Short introduction to Ordinary and Partial Differential Equations, Politechnika Wroclawska, 2011.

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

Katedra Geotechniki, Hydrotechniki, Budownictwa Podziemnego i Wodnego:

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
Mathematics – selected topics
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY *Civil Engineering*
AND SPECIALIZATION **Civil Engineering**

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)**	Subject objectives ***	Programme content ***	Teaching tool number ***
Knowledge				
PEK_W01	K2_W01	C1, C2	Lec1-Lec4 C11-C13	N1-N4
PEK_W02	K2_W01	C4-C5	Lec5- Lec7 C15-C17	N1-N4
PEK_W03	K2_W01	C4-C5	Lec1, Lec7, Lec8 C13, C14, C18	N1-N4
Skills				
PEK_U01	K2_U08	C1, C3, C4	Lec1,Lec2, Lec7 C11, C12, C14	N1-N4
PEK_U02	K2_U08	C1,C2	Lec2, Lec3 C12, C13	N1-N4
PEK_U03	K2_U08	C4, C5	Lec6	N1-N4
PEK_U04	K2_U08	C4, C5	Lec7, Lec8	N1-N4
Social competence				
PEK_K01	K2_K01, K2_K02	C2, C3	C11-C18	N2-N4
PEK_K02	K2_K03, K2_K06	C1-C5	C11-C18 Lec1-Lec8	N1-N4

** - enter symbols for main-field-of-study/specialization educational effects

*** - from table above