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) Basic concepts: guide to the basic concepts of topological conventions signs, basic definitions, classification - linear equations, half-linear quasi-linear examples.	1
Lec2	Linear partial differential equations of second order on the plane Classification, characteristic equation, performance, bringing hyperbolic, parabolic and elliptical to a canonical form.	2
Lec3	The d'Alembert and Fourier 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	Laplace equation physics issues leading to the Laplace equation, harmonic functions, removing the fundamental solution, maximum principle, uniqueness of solutions.	2
Lec5	Normed spaces linear spaces, normed metric spaces, functional spaces, Banach space, unitary space, Hilbert space, the Pythagorean theorem, theorem on orthogonal projection.	2

Lec6	Sobolev spaces compactly supported functions, linear functionals, distribution, distribution derivatives, Sobolev space, spatial properties of H^1.	2
Lec7	Generalized solutions of elliptic equations II row Weak formulation of boundary value problems, Lax-Milgram theorem, application of Lax-Milgram theorem.	2
Lec8	Methods of variational equations 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 Differentia Equqtions, Politechnika Wrocławska, 2011.

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

Katedra Geotechniki, Hydrotechniki, Budownictwa Podziemnego i Wodnego:

dr hab.inż. Wojciech Puła, wojciech.pula@pwr.edu.pl

MEMBERS OF TEH EDUCATIONAL TEAM (NAME AND SURNAME, E-MAIL ADDRESS)

dr inż. Andrzej Janczura, andrzej.janczura@pwr.wroc.pl
dr inż. Marek Kopiński, marek.kopinski@pwr.wroc.pl

dr hab. inż. Piotr Ruta, piotr.ruta@pwr.wroc.pl

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 Cl1-Cl3	N1-N4
PEK_W02	K2_W01	C4-C5	Lec5- Lec7 Cl5-Cl7	N1-N4
PEK_W03	K2_W01	C4-C5	Lec1, Lec7, Lec8 Cl3, Cl4, Cl8	N1-N4
Skills				
PEK_U01	K2_U08	C1, C3, C4	Lec1,Lec2, Lec7 Cl1, Cl2, Cl4	N1-N4
PEK_U02	K2_U08	C1,C2	Lec2, Lec3 Cl2, Cl3	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	Cl1-Cl8	N2-N4
PEK_K02	K2_K03, K2_K06	C1-C5	Cl1-Cl8 Lec1-Lec8	N1-N4

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