DOCTORAL SCHOOL OF WROCŁAW UNIVERSITY OF SCIENCE AND TECHNOLOGY

SUPERVISOR/TEAM/ DECLARING/CONDUCTING COURSE: Henryk Kudela
DEPARTMENT: Faculty of Mechanical and Power Engineering W9
SCIENTIFIC DISCIPLINE: Environmental Engineering, Mining and Energy

COURSE CARD

Course name in Polish: Zastosowanie równań różniczkowych cząstkowych w praktyce inżynierskiej z wykorzystaniem programu MATHEMATICA/Matlab
Course name in English:
Applications of partial differential equations in engineering practice with utilization of MATHEMATICA/Matlab
Course language Polish / ~~English~~*
University-wide general course type*:
The course is intended for all PhD students: YES / NO
1) BASIC COURSE
~~2) SPECIALIST COURSE~~
~~3) SEMINAR~~
~~4) HUMANISTIC COURSE~~
~~5) LANGUAGE~~

Subject code: IGQ000003W

* delete as applicable

	Lecture	Foreign language course	Seminar	Mixed forms
Number of hours of organized classes in university (ZZU)	30			
Grading	Exam	Exam	Oral presentation	Exam, inspection, evaluation classes
Number of ECTS points	**0**			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Mathematical analysis II

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COURSE OBJECTIVES

C1 Pass the fundamental knowledge of the theoretical and practical aspects that relates to the fundamental method of the analytical solutions for partial differential equations

C1.1. Acquire of the knowledge about partial differential equations suitable for description of diffusion processes, wave propagation and stationary distribution of temperature and potentials

C2. Skills acquire for choosing of proper type partial differential equations, proper boundary conditions for different physical phenomena and acquire ability for use the MATHEMATICA program

PROGRAM CONTENTS

Form of classes – lecture (Lec)Wa1		Number of hours
Lec1	Introduction to MATHEMATICA – elementary functions and solution of differential equations	2
Lec2	Refreshing of some knowledge from the ordinary differentia equations: linear differential equation of first order: general solution and particular solution. Second order equations- simple oscillator equation undamped and damped vibration. Presentation of solution in MATHEMATICA	2
Lec3	Partial differentia equation of the first order. Method of characteristics	2
Lec4	Analytical solution of the first order partial differential equations using the MATHEMATICA. Animation.	2
Lec5	Parametric solution of the first order partial differential equations of the first order. Presentation solutions in MATHEMATICA. Animation.	2
Lec6	Classification of second order equation. Reduction to canonical form	2
Lec7	Parabolic equations – heat conduction and diffusion equations. Fourier law. Dirichlet, Neuman and Robin boundary value problem. Method of variable separation. Uniqueness and continuous dependence from initial conditions.	2
Lec8	Generalized Fourier's series. Gram-Schmidt ortogonaliztion. The best approximation theorem. Bessel's inequality and Parseval equality.	2
Lec9	Calculation of Fourier series coefficients. Gibbs phenomenon. Mean square error of approximation.	2
Lec10	Waves in unlimited space. D'Alambert formula. Separtion of variables for vibrating string.	2
Lec11	Two dimensional problem of vibrating membrane. Bessel's function. Animation of soutions.	2
Lec12	Elliptic equations. Laplace equation. Properties of harmonic functions. Dirichlet and Neumann problem for Laplace equation. Theorem about minimum of potential energy.	2
Lec13	Separation variable method for Laplace equation and Poisson equation	2
Lec14	Laplace equation in cylindrical coordinates and solution for circle.	2
Lec15	Green integral identities. Divergence Gauss theorem and properties of Laplace eqiuation.	2
	Total hours:	**30**

TEACHING TOOLS USED

N1. Traditional lectures using multimedia presentation
N2. List of problems for self-study
N3. Consultation
N4. self-study – preparation for exams

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ACHIEVED SUBJECT LEARNING OUTCOMES		
Type of learning outcome	Code of learning outcome	Assessment of learning outcome
Knowledge	**P8S_WG**	Student has a sound knowledge of basic subjects such as mathematics, physics, chemistry or others

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1]. S. J. Farlow Partial differential equations for sceintists and engineers, Dover Publications, Inc., 1993
[2]. M. A. Pinsky, *Partial Differential Equations and Boundary-Value Problems with Applications*, AMS,2011
[3].. D. Vvedensky, *Partial differential equations with MATHEMATICA*, Addisin-Wesley, 1992.
[4]. I. Pietrowski *Równania różniczkowe cząstkowe*, PWN 1955.

SECONDARY LITERATURE:

[5]. M.P. Coleman, *An introduction to partial differential equations with MATLAB*, Chapman&Hall, 2000
[6]. A. Tveito, R. Winther, *Introduction to partial differential equations, Computational approach,* Springer
[7] H. Ruskeepaa, *MATHEMATICA NAVIGATOR, Mathematics, Statistics and Graphics*, Academic Press,

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

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