WROCŁAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES

FACULTY OF PURE AND APPLIED MATHEMATICS

SUBJECT CARD

Course name in Polish: Zastosowania Równań Różniczkowych Cząstkowych

Course name in English: Applied Partial Differential Equations

Course language: Polish

University-wide general course type:
1) basic course (mathematics, physics, chemistry, other)
2) humanity course
3) managerial skills
4) English language
5) other modern language

Departmental course developing professional skills:
1) specialized course
2) interdisciplinary course
3) seminar (interdisciplinary, specialized, departmental)

Type of course (obligatory, optional)

Educational effects according to ZW 26/2017 regulations:
P8S_WG, **P8S_UW**, **P8S_KK**, **P8S_KR**

Subject code: MAT1310

*delete as applicable

	Lecture
Number of hours of organized classes in University (ZZU)	30
Number of hours of total student workload (CNPS)	90
Form of crediting	Exam
Number of ECTS points	3
including number of ECTS points for practical (P) classes	
including number of ECTS points for direct teacher-student contact (BK) classes	2

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows the basic theory of calculus, ordinary differential equations and vector fields.
2. Student is able to search for supplementary material in various areas of knowledge.

SUBJECT OBJECTIVES	
C1	Student will learn selected topics in the theory and applications of partial differential equations
C2	Student will acquire skills of applying learnt material in fields where there is a need for using partial differential equations.

WROCŁAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES

SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:

PEK_W01 – Student knows the most important analytical methods for solving partial differential equations

PEK_W02 – Student possesses knowledge concerning applications of differential equations in various fields of science.

Relating to skills:

PEK_U01 – Student gains skills needed to perform his/her research.

PEK_U02 – Student is able to conduct his/her reaserch.

Relating to social competences:

PEK_K01 – Student is aware of the role of cooperation, including an international cooperation.

PEK_K02 – Student is aware of the importance of the original research activity

PROGRAM CONTENTS		
Form of classes – lecture		Number of hours
Lec 1	The meaning of differential equations in mathematical modelling. Examples introducing partial differential equations of the first degree. Conservation laws.	2
Lec 2	Method of characteristics and Charpit's. Eikonal equation.	2
Lec 3	Inviscid Burgers equations: weak solutions. Rankine-Hugoniot's condition. Shock waves. Applications in various sciences.	4
Lec 4	Systems of first order equation. Shallow water equations and gas dynamics. A model of A-bomb (or supernova) explosion.	4
Lec5	Derivation of the heat equation. Separation of variables. Fundamental solution. Solution of Cauchy problem on several domains. Applications in technology, physics and geology.	4
Lec6	Free-boundary problems. Stefan problem. A model of freezing lake.	2
Lec7	Nonlinear parabolic equations. Self-similar solutions. Porous medium equation and Barenblatt's solution. A model of glacier movement. Fisher's equation.	2
Lec8	Gravitational potential and derivation of the Laplace and Poisson equations. Remark concerning separation of variables. Fundamental solution and Green's function. Integral representation of solutions. Applications in electrostatics, geological surveying and astrophysics.	4
Lec9	Derivation of vibrating string equations and its generalization for higher dimension. d'Alembert's and spherically symmetric solutions. Mechanical, acoustic and electromagnetic waves.	4
Lec10	Derivation of the Navier-Stokes equations. Remark concerning existence and uniqueness. Primitive equations of geophysical fluid dynamics. Geostrophic balance. Taylor-Proudman Theorem. Weather forecast.	2
	Total hours	30

WROCŁAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES

TEACHING TOOLS USED	
N1	lecture
N2	consultation
N3	homework: solving problems and exercises

EVALUATION OF ACHIEVED SUBJECT EDUCATIONAL EFFECTS		
Evaluation: F – forming (partial) C – concluding	Educational effect number	Way of evaluating achievement of educational effects
F1	PEK_U01, PEK_U02, PEK_W01, PEK_W02	attendance of lectures
F2	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_K01, PEK_K02	solving problems and exercises
C = 0.5*F1 + 0.5*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] R. Haberman, Applied Partial Differential Equations with Fourier Series and Boundary Value Problems, Pearson, 2012.
[2] A.N. Tichonow, A. A. Samarski, Równania fizyki matematycznej, PWN, 1963.
[3] J.D. Logan, An Introduction to Nonlinear Partial Differential Equations, John Wiley & Sons, 2008.
[4] P. Markowich, Applied Partial Differential Equations: A Visual Approach, Springer Science & Business Media, 2007.

SECONDARY LITERATURE:

[1] G.B. Whitham, Linear and Nonlinear Waves, John Wiley & Sons, 2011.
[2] J. R. Ockendon, Applied Partial Differential Equations, Oxford University Press, 2003.
[3] L.C. Evans, Równania różniczkowe cząstkowe, PWN, 2008.
[4] W.A. Strauss, Partial Differential Equations, New York: Wiley, 1992.

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
dr inż. Łukasz Płociniczak, lukasz.plociniczak@pwr.edu.pl

WROCŁAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT APPLIED PARTIAL DIFFERENTIAL EQUATIONS AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Doctoral studies at Faculty of Pure and Applied Mathematics

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	**P8S_WG**	C1,C2	Lec1-10	N1, N2, N3
PEK_W02	**P8S_WG**	C1,C2	Lec1-10	N1, N2, N3
(skills) PEK_U01	**P8S_UW**	C2	Lec1-10	N2, N3
PEK_U02	**P8S_UW**	C2,C3	Lec1-10	N2, N3
(competences) PEK_K01	**P8S_KK**	C3	Lec1-10	N1, N2
PEK_K02	**P8S_KR**	C3	Lec1-10	N1, N2

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

*** - from table above