Zał. nr 4 do ZW 64/2012

FACULTY OF PURE AND APPLIED MATHEMATICS
SUBJECT CARD

Name in Polish: Zagadnienia ze swobodnym brzegiem
Name in English: Free boundary problems
Main field of study (if applicable): APPLIED MATHEMATICS
Specialization (if applicable): Mathematics for Industry and Commerce
Level and form of studies: ~~1st/~~ 2nd* level, full-time / ~~part-time~~*
Kind of subject: ~~obligatory~~/ optional / ~~university-wide~~*
Subject code XXX
Group of courses YES / ~~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)	150				
Form of crediting	Crediting with grade				
For group of courses mark (X) final course	X				
Number of ECTS points	5				
including number of ECTS points for practical (P) classes	2	2			
including number of ECTS points for direct teacher-student contact (BK) classes	1,5	1,5			

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student has basic knowledge and abilities in the area of ordinary and partial differential equations.

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SUBJECT OBJECTIVES

C1 Study of mathematical models of phenomena in science and technology leading to free boundary problems.
C2 Study of basic analytical methods in examining free boundary problems.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge: student
PEK_W01 knows basic mathematical models connected with free boundary problems.
PEK_W02 knows basic analytical methods in examining free boundary problems.

relating to skills: student
PEK_U01 can build mathematical models leading to free boundary problems.
PEK_U02 can examine free boundary problems.

relating to social competences: student

PEK_K01 is able to take benefits form scientific literature
PEK_K02 knows limitations of his knowledge and understands the need of further education.

PROGRAMME CONTENT

Form of classes - lecture		**Number of hours**
Lec 1	Remaining basic theory of elliptic and parabolic partial differential equations.	2
Lec 2	Stefan problem, notion of the free boundary. Inverse Stefan problem.	2
Lec 3	Free boundary problems in melting and freezing. Modeling of problems connected with phase transition.	4
Lec 4	Modeling of flows in porous media: Boussinesq equation, porous media equation.	2
Lec 5	Self-similar solutions of porous media equation.	2
Lec 6	Free boundary in solutions of porous media equation, finite speed of propagation of disturbances. Retention and penetration property. Large time behavior of solutions.	2
Lec 7	Free boundary in reaction–diffusion–convection equations.	4
Lec 8	Diffusion in solids. Free boundary problems.	2
Lec 9	Modeling of flows in deformable media, spreading of impurities.	4
Lec 10	Free boundary problems in digital image processing.	2
Lec 11	Free boundary problems in financial mathematics.	2
Lec 12	Stationary free boundary problems: dam problem, obstacle problems in calculus of variations.	2
	Total hours	30

Form of classes - class		**Number of hours**
Cl 1	Solving of problems illustrating theory given on lectures.	30
	Total hours	**30**

TEACHING TOOLS USED

N1. Lecture – traditional method.
N2. Classes – traditional method.

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	PEK_W1, PEK_K1	Final test
F2	PEK_U1, PEK_U2, PEK_K1	Oral presentations, tests.
P= 0.5*F1+0.5*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] R. M. Mattheij, S. W. Rienstra, J.H.M. ten Thije Boonkkamp, Partial Differential Equations, Modeling, Analysis, Computation, SIAM, Philadelphia 2005

[2] J. Ockendon, S. Howison, A. Lacey & A. Movchan, Applied Partial Differential Equations, Oxford University Press, Oxford 1999.

[3] A. Fasano, Parabolic Free Boundary Problems in Industrial and Biological Applications, SIMAI e-Lecture Notes, Volume 9, 2011

SECONDARY LITERATURE:

[1] V. Alexiades, A.D. Solomon, Mathematical Modeling of Melting and Freezing Processes, Hemisphere – Taylor & Francis, Washington, DC, USA, 1983

[2] J.L. Vazquez, The Porous Media Equation, Mathematical Theory, Clarendon Press, Oxford 2007

[3] A.Friedman, Variational Principles and Free Boundary Problems, John Wiley and Sons, Inc

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

Dr hab. Jan Goncerzewicz (Jan.Goncerzewicz@pwr.edu.pl**)**

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

FREE BOUNDARY PROBLEMS MAT001576

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **APPLIED MATHEMATICS** AND SPECIALIZATION **MATHEMATICS FOR INDUSTRY AND COMMERCE**

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***
PEK_W01 (knowledge)	K2MST_W03 K2MST_mic_W01	C1, C2	Lec 1 - Lec 12	F1
PEK_W02	K2MST_W10 K2MST_mic_W02 K2MST_mic_W03	C1, C2	Lec 1 - Lec 12	F1
PEK_U01 (skills)	K2MST_U15 K2MST_U24 K2MST_U25	C1, C2	Cl 1	F2
PEK_U02	K2MST_U28 K2MST_U29 K2MST_U16	C1, C2	Cl 1	F2
PEK_K01 (competences)	K2MST_K06 K2MST_mic_K01	C1, C2,	Lec 1 - Lec 12, Cl 1	F2
PEK_K02	K2MST_K01 K2MST_mic_K02	C1-C2	Wy1-Wy11, Ćw1	1, 2, 3, 4

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

*** - from table above