Zał. nr 4 do ZW 64/2012

FACULTY OF PURE AND APPLIED MATHEMATICS
SUBJECT CARD

Name in Polish: METODY NUMERYCZNE W RÓWNANIACH RÓŻNICZKOWYCH
Name in English: Numerical methods in differential equations
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 MAT1552
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)	90		60		
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	X				
Number of ECTS points	3		2		
including number of ECTS points for practical (P) classes			3		
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 on mathematical analysis.
2. Student has basic knowledge concerning programming environments: Matlab/Mathematica/Mapple.

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SUBJECT OBJECTIVES

C1 Study of basic notions and knowledge in the area of numerical methods applied in differential equations
C2 Study of basic numerical techniques used in discretization of differentia equations.
C3 Acquisition of basis abilities in construing and analyzing difference schemes for differential equations

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge student:

PEK_W01 knows the most important numerical techniques used in solving problems for differential equations

PEK_W02 knows bases of construing own numerical schemes

relating to skills student:

PEK_U01 is able to analyze basic problems in differential equations with respect to application of suitable approximate methods

PEK_U02 is able to construct mathematical models used in concrete applications of mathematics, based on differential equations and their discrete forms.

…relating to social competences:

PEK_K01 can, without assistance, search for necessary information in the literature

PEK_K02 understands necessity of systematic and individual work on the material of the course.

PROGRAMME CONTENT

Form of classes - lecture		**Number of hours**
Lec 1	Recalling basic facts of theory of ordinary differential equations.	2
Lec 2	Explicit and implicit Euler method of approximate solving of ordinary differential equations and their systems.	2
Lec 3	Runge-Kutta type methods and other schemes of approximation of ordinary differential equations and their systems.	2
Lec 4	Multi-step methods, stability of numerical methods. Stiff problems.	2
Lec 5	Methods of approximation of boundary value problems for second order ordinary differentia equations: shooting methods and difference methods.	2
Lec 6	Methods of approximation of boundary value problems for second order ordinary differentia equations: Ritz-Galerkin method.	2
Lec 7	Difference methods for first order partial differentia equations. CFL condition.	2
Lec 8	Recalling basic facts of theory of second order partial differential equations.	2
Lec 9	Difference approximation of elliptic boundary value problems on the plane.	2
Lec 10	Variational formulation of boundary value problems for elliptic type equations.	2
Lec 11	Ritz-Galerkin and finite element methods for elliptic problems.	2
Lec 12	Difference methods for parabolic problems. Explicit and implicit schemes for heat conduction equation.	2
Lec 13	Stability of approximate method. Cranck-Nicholson scheme for equations of parabolic type.	2
Lec 14	Difference methods for the vibrating string problem and other hyperbolic problems.	4
	Total hours	30

Form of classes - laboratory		Number of hours
Lab 1	Computer construction of solution of ordinary differentia equations.	4
Lab 2	Practical verifying of efficacy of automatic exactness control.	2
Lab 3	Visualization and comparison of usefulness of various methods.	4
Lab 4	Algorithms for numerical methods of solution of one-dimensional boundary value problems for elliptic equations.	4
Lab 5	Discretisation of hyperbolic first order problems. Conditions of stability and convergence of approximate methods.	4
Lab 6	Discretization of two-dimensional boundary value problem for elliptic equations.	4
Lab 7	Difference schemes of approximation of one-dimensional parabolic equation.	4
Lab 8	Difference method of discretization of the vibrating string equation.	4
	Total hours	

TEACHING TOOLS USED

N1. Lecture – traditional method.
N2. Problem and computing laboratory – traditional and using computers method.
N3. Consultations.
N4. Student's personal work – preparation for the laboratory.

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_W01 PEK_W02 PEK_K01	Presentation of given problems.
F2	PEK_U01 PEK_U02 PEK_K01	Oral presentations, tests.
P=0.5*F1+0.5*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Richard L. Burden, J. Douglas Faires, Numerical Analysis.
[2] R. M. Mattheij, S. W. Rienstra, J.H.M. ten Thije Boonkkamp, Partial differential equations. Modeling, analysis and computations.
[3] Stig Larsson, Vidar Thomee, Partial differential equations with numerical methods.

SECONDARY LITERATURE

[1] L. Lapidus, G. F. Pinder, Numerical solution of partial differential equations in science and engineering, John Wiley & Sons, 1998
[2] R. J. Le Vegue, Numerical Methods for conservation laws, Birkhauser, Basel 1990
[3] J. W. Thomas, Numerical partial differential equations: conservation laws and elliptic equations, Springer, New York 1999

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

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

NUMERICAL METHODS IN DIFFERENTIAL EQUATIONS MAT1552

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)	K2MIC_W03	C1-C3	Lec1- Lec14	1,3
PEK_W02	K2MIC_W10	C1-C3	Lec1- Lec14	1,3
PEK_U01 (skills)	K2MIC_U15, K2MIC_U28, K2MIC_U29	C1-C3	La1-La8	2,3,4
PEK_U02	K2MIC_U16	C1-C3	La1-La8	2,3,4
PEK_K01 (competences)	K2MIC_K06	C1-C3	Lec1- Lec14, La1-La8	1,2,3,4
PEK_K02	K2MIC_K01	C1-C3	Lec1- Lec14, La1-La8	1,2,3,4

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

*** - from table above