Zał. nr 4 do ZW 64/2012

FACULTY OF PURE AND APPLIED MATHEMATICS
SUBJECT CARD

Name in Polish: Wstep do matematycznych metod przetwarzania obrazu
Name in English: Introduction to Mathematical Image Processing
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 MAT1549
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			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 knows basic concepts of functional analysis
2. Knows basic concepts of theory of partial differential equations
3. Knows and can apply basic methods of variational calculus
4. Knows at least one package for mathematical computing
5. Knows basic numerical methods for solving partial differential equations

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SUBJECT OBJECTIVES

C1 Study of fundamental mathematical models in image processing
C2 Study of numerical methods for solving problems of filtering, segmentation and decomposition of image
C3 Application of acquired knowledge to construction and analysis of mathematical models in image processing

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEK_W01 knows basic models of image filtering
PEK_W02 knows basic models of image segmentation
PEK_W03 knows the Meyer decomposition model
PEK_W04 knows numerical methods for solving fundamental problems in image processing

relating to skills:
PEK_U01 be able to demonstrate the equivalence of known models of image filtering
PEK_U02 be able to demonstrate the equivalence of known models of image segmentation
PEK_U03 be able to apply numerical methods to solve approximate solutions to mathematical models in image processing

relating to social competences:
PEK_K01 can, without assistance, search for necessary information in the literature.
PEK_K02 understands the need for systematic work on course material

PROGRAMME CONTENT

Form of classes - lecture		**Number of hours**
Lec 1	Overview of fundamental problems in image processin. Image degradation models	2
Lec 2	Models of image denoising: linear diffusion filter, nonlinear diffusion filters, variational models for image denoising, wavelets models for image denoising, nonlocal filters.	12
Lec 3	Discretization of selected image denoising model	2
Lec 4	Models of image segmentation: variational model of Mumford-Shah and its approximations, stochastic model of Geman-Geman, active contours model	8
Lec 5	Discretization of selected image segmantation model	2
Lec 6	Image decomposition model of Meyer and methods of its solution	4
	Total hours	**30**

Form of classes - laboratory		**Number of hours**
Lab 1	Basic operation on images. Degradation of images	2
Lab 2	Implementation of nonlinear diffusion filter	6
Lab 3	Implemantation of the algorithm for minimization of the Rudin, Osher and Fatemi model	4
Lab 4	Implementation of the algorithm for minimization of the Mumfors-Shah model	6
Lab 5	Implementation of evolution equation related with the active contour model	6
Lab 6	Implementation of the algorithm for image decomposition	6
	Total hours	**30**

TEACHING TOOLS USED
N1. Lecture – traditional method supported by multimedial presentation N2. Computer laboratory – working on a computer using a software package for numerical computations N3. Consultations N4. Student's self 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_W04, PEK_U03, PEK_K01,	activity in the laboratory, oral presentation, projects, raports
F2	PEK_W01, PEK_W02, PEK_W03, PEK_W04, PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02,	test
P==0.5*F1+0.5*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] G. Aubert and P. Kornprobst „Mathematical Problems in Image Processing: Partial Differential Equations and the Calculus of Variations", Springer-Verlag, 2007.

[2] T. Chan and J. Shen „Image Processing And Analysis: Variational, PDE, Wavelet, And Stochastic Methods", SIAM, 2006.

SECONDARY LITERATURE:

[1] O. Scherzer (Editor) „Handbook of Mathematical Methods in Imaging", Springer-Verlag, 2010.

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

Dr Monika Muszkieta (Monika.Muszkieta@pwr.wroc.pl)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

Introduction to Mathematical Image Processing MAT1549

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)**lności (o ile dotyczy)**	**Subject objectives*****	**Programme content*****	**Teaching tool number*****
PEK_W01 (knowledge)	K2MIC_W04, K2MIC_W06, K2MIC_W07, K2MIC_W13	C1, C3	Lec 1, Lec 2, Lab 2, Lab 3	1, 2, 3
PEK_W02	K2MIC_W04, K2MIC_W06, K2MIC_W07, K2MIC_W13	C1, C3	Lec 1, Lec 4, Lab 4, Lab 5	1, 2, 3
PEK_W03	K2MIC_W04, K2MIC_W06, K2MIC_W07, K2MIC_W13	C1, C3	Lec 6, Lab 6	1, 2, 3
PEK_W04	K2MIC_W08, K2MIC_W10, K2MIC_W12, K2MIC_W13	C2	Lec 3, Lec 5, Lab 1-Lab 6	1, 2, 3, 4
PEK_U01 (skills)	K2MIC_U04, K2MIC_U05, K2MIC_U06, K2MIC_U09	C1, C3	Lec 2, Lab 2, Lab 3	1, 2, 3
PEK_U02	K2MIC_U04, K2MIC_U05, K2MIC_U06, K2MIC_U09	C1, C3	Lec 4, Lab 4, Lab 5	1, 2, 3
PEK_U03	K2MIC_U16, K2MIC_U17	C2	Lec 3, Lec 5, Lab 1-Lab 6	1, 2, 3, 4
PEK_K01 (competences)	K2MIC_K05, K2MIC_K06	C1, C2, C3	Lec 1- Lec 6, Lab 1-Lab 5	1, 2, 3, 4
PEK_K02	K2MIC_K03, K2MIC_K04	C1, C2, C3	Lec 1- Lec 6, Lab 1-Lab 5	1, 2, 3, 4

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

*** - from table above