Zał. nr 4 do ZW 64/2012

FACULTY OF PURE AND APPLIED MATHEMATICS
SUBJECT CARD

Name in Polish: Matematyczne przetwarzanie obrazów
Name in English: Mathematical Image Processing
Main field of study (if applicable): APPLIED MATHEMATICS
Specialization (if applicable): MODELLING, SIMULATION, OPTIMIZATION
Level and form of studies: ~~1st/~~ 2nd* level, full-time / ~~part-time~~*
Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~*
Subject code MAT001582
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	~~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	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. Knows basic concepts of theory of partial differential equations
2. Knows MATLAB package for mathematical computing

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SUBJECT OBJECTIVES

C1 Study of mathematical models in image processing.
C2 Study of numerical methods for solving problems in image processing.
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 for image restoration
PEK_W02 knows basic variational models for image segmentation
PEK_W03 knows numerical methods for solving problems in image processing

relating to skills:
PEK_U01 be able to demonstrate the difference between known models of image restoration
PEK_U02 be able to demonstrate the difference between known models of image segmentation
PEK_U03 be able to apply numerical methods to solve mathematical problems 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 processing. Representation of images. Models of image degradation.	2
Lec 2	Linear diffusion filter. Gaussian smoothing in the frequency domain.	2
Lec 3	Nonlinear diffusion filters. Isotropic and anisotropic diffusion models.	4
Lec 4	Discretization of the nonlinear diffusion filter.	2
Lec 5	Introduction to variational models for image restoration.	2
Lec 6	Image denoising by total variation regularization.	2
Lec 7	First order numerical schemes for total variation minimization.	4
Lec 8	Image deblurring model.	2
Lec 9	Total variation model for image inpainting.	2
Lec 10	The Mumford-Shah model for image segmentation and its approximations.	4
Lec 11	Active contours model for image segmentation.	4
	Total hours	**30**

Form of classes - laboratory		**Number of hours**
Lab 1	Basic operation on images. Degradation of images. Gaussian smoothing.	4
Lab 2	Solving selected problems illustrating theory given in the lectures using mathematical MATLAB package for numerical computing	26
	Total hours	**30**

TEACHING TOOLS USED
N1. Lecture – traditional method supported by multimedial presentation N2. Computer laboratory – working on a computer using MATLAB package for numerical computations N3. Consultations N4. Student's self work – work on the project

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_W03, PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02,	activity in the laboratory
F2	PEK_W01, PEK_W02, PEK_W03, PEK_U01, PEK_U02, PEK_U03, PEK_K01, PEK_K02,	oral presentation, report
P==0.2*F1+0.8*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.edu.pl)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
MATHEMATICAL IMAGE PROCESSING MAPXXXX
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY
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_W04, K2MST_mso_W01	C1, C2, C3	Lec 1, Lec 2, Lec 3, Lec 5, Lec 6, Lec 8, Lec 9 Lab 1, Lab 2	1, 2, 3, 4
PEK_W02	K2MST_W06, K2MST_mso_W02	C1, C2, C3	Lec 10, Lec 11 Lab 1, Lab 2	1, 2, 3, 4
PEK_W03	K2MST_W07 K2MST_W13 K2MST_mso_W03	C1, C2, C3	Lec 4, Lec 7 Lab 1, Lab 2	1, 2, 3, 4
PEK_U01 (skills)	K2MST_U04 K2MST_U05, K2MST_U06, K2MST_mso_U01	C1, C2, C3	Lec 1, Lec 2, Lec 3, Lec 5, Lec 6, Lec 8, Lec 9 Lab 1, Lab 2	1, 2, 3, 4
PEK_U02	K2MST_U09 K2MST_U16 K2MST_mso_U01	C1, C2, C3	Lec 10, Lec 11 Lab 1, Lab 2	1, 2, 3, 4
PEK_U03	K2MST_U17 K2MST_U24 K2MST_U25 K2MST_mso_U03	C1, C2, C3	Lec 4, Lec 7 Lab 1, Lab 2	1, 2, 3, 4
PEK_K01 (competences)	K2MST_K05 K2MST_K06 K2MST_mso_K01	C1, C2, C3	Lec 1- Lec 11, Lab 1, Lab 2	1, 2, 3, 4
PEK_K02	K2MST_K03 K2MST_K04 K2MST_mso_K02	C1, C2, C3	Lec 1- Lec 11, Lab 1, Lab 2	1, 2, 3, 4

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