Zał. nr 5 do ZW 16/2020

FACULTY OF PURE AND APPLIED MATHEMATICS

SUBJECT CARD

Name of subject in Polish: Matematyczne przetwarzanie obrazów
Name of subject in English: Mathematical Image Processing
Main field of study (if applicable): Applied Mathematics
Specialization (if applicable): MODELLING, SIMULATION, OPTIMIZATION
Profile: academic / practical*
Level and form of studies: 2nd level/ full-time
Kind of subject: optional
Subject code MAT001582
Group of courses YES

	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	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 classes (P)	2		2		
including number of ECTS points corresponding to classes that require direct participation of lecturers and other academics (BU)	1,5		1,5		

*delete as not necessary

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

\

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:
PEU_W01 knows basic models for image restoration
PEU_W02 knows basic variational models for image segmentation
PEU_W03 knows numerical methods for solving problems in image processing

relating to skills:
PEU_U01 be able to demonstrate the difference between known models of image restoration

PEU_U02 be able to demonstrate the difference between known models of image segmentation
PEU_U03 be able to apply numerical methods to solve mathematical problems in image processing

relating to social competences:
PEU_K01 can, without assistance, search for necessary information in the literature.
PEU_K02 understands the need for systematic work on course material

PROGRAMME CONTENT		
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**

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 LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming (during semester), P –	Educational effect number	Way of evaluating educational effect achievement

concluding (at semester end)		
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)