FACULTY OF PURE AND APPLIED MATHEMATICS

SUBJECT CARD

Name in Polish: Wprowadzenie do Problemów Odwrotnych
Name in English: Introduction to Inverse Problems
Main field of study (if applicable): Applied Mathematics
Specialization (if applicable): Mathematics for industry and commerce, modeling, simulation, opimalization
Profile: academic / practical*
Level and form of studies: 2nd* level, full-time /
Kind of subject: optional
Subject code
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 (P) classes	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 applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows basic facts of mathematical analysis.
2. Knows MATLAB package for mathematical computing.

\

SUBJECT OBJECTIVES

C1 Study of classical examples of inverse problems.
C2 Study of theory and basic concepts for inverse problems.
C3 Study of numerical methods for solving inverse, ill-posed problems.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 knows the definition of well-posedness
PEU_W02 knows classical examples of inverse problems
PEU_W03 knows basic methods of regularization
PEU_W04 knows numerical methods for solving inverse problems

relating to skills:
PEU_U01 understand the definition of well-posedness
PEU_U02 be able to demonstrate examples of inverse problems
PEU_U03 be able to apply numerical methods to solve inverse problems

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	Introduction to inverse problems. Definition of the well-posedness. Important classes of inverse problems.	2
Lec 2	Differentiation of a noisy data.	2
Lec 3	Computerized tomography. The Radon transform.	2
Lec 4	Inverse problems in image processing.	2
Lec 5	Parameter identification problems.	4
Lec 6	Ill-conditioned matrix equations	2
Lec 7	Regularization of linear ill-posed problems.	4
Lec 8	Tikhonov regularization.	2
Lec 9	Maximum entropy regularization.	2
Lec 10	Total variation regularization.	2
Lec 11	Estimation of the regularization parameters.	2
Lec 12	Iterative regularization	4
	Total hours	**30**

	Laboratory	**Number of hours**
Lab 1	Solving problems illustrating the methods given in the lecture using MATLAB package for scientific computing	30
	Total hours	**30**

TEACHING TOOLS USED
N1. Lecture – traditional method N2. Computer laboratory – working on a computer using MATLAB 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	PEU_W03, PEU_W04, PEU_U03, PEU_K01, PEU_K02	activity in the laboratory, oral presentation
F2	PEU_W01, PEU_W02, PEU_W03, PEU_W04, PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02,	test
P==0.5*F1+0.5*F2		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] C. W. Groetsch. "Inverse Problems in the Mathematical Sciences". Vieweg, Braunschweig, 1993. [2] C. R. Vogel. „Computational Methods for Inverse Problems". SIAM, Philadelphia, PA, USA, 2002. **SECONDARY LITERATURE:** [1] H. W. Engl, M. Hanke, and A. Neubauer. "Regularization of Inverse Problems". Kluwer Academic Publishers, Dordrecht, 1996. [2] A. A. Samarskii and P. N. Vabishchevich. "Numerical Methods for Solving Inverse Problems of Mathematical Physics". Walter de Gruyter, 2007.
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
Dr Monika Muszkieta (monika.muszkieta@pwr.edu.pl)