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,
MODELLING, SIMULATION, OPTIMIZATION
Level and form of studies: ~~1st~~/ 2nd* level, full-time / ~~part-time~~*
Kind of subject: ~~obligatory~~/ optional / ~~university-wide~~*
Subject code   MAT001575
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.   Student knows basic facts of mathematical analysis.
2.   Knows MATLAB package for mathematical computing.
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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: PEK_W01 knows the definition of well-posedness PEK_W02 knows classical examples of inverse problems PEK_W03 knows basic methods of regularization PEK_W04 knows numerical methods for solving inverse problems relating to skills: PEK_U01 understand the definition of well-posedness PEK_U02 be able to demonstrate examples of inverse problems PEK_U03 be able to apply numerical methods to solve inverse problems 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 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**

Form of classes - 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	PEK_W03, PEK_W04, PEK_U03, PEK_K01, PEK_K02	activity in the laboratory, oral presentation
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] 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)

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
INTRODUCTION TO INVERSE PROBLEMS MAT001575
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **APPLIED MATHEMATICS**
AND SPECIALIZATION **MATHEMATICS FOR INDUSTRY AND COMMERCE**
MODELLING, SIMULATION, OPTIMIZATION

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)	K2MST_W06 K2MST_W08, K2MST_mic_W01 K2MST_mso_W01	C1, C2, C3	Lec 1,	1
PEK_W02	K2MST_W07 K2MST_W10 K2MST_mic_W02 K2MST_ mso _W02	C1, C2, C3	Lec 1 - Lec 6, Lab 1	1, 2, 3
PEK_W03	K2MST_W13 K2MST_W12 K2MST_mic_W03 K2MST_ mso _W03	C1, C2, C3	Lec 7 – Lec 12, Lab 1	1, 2, 3
PEK_W04	K2MST_W04	C1, C2, C3	Lec 2 - Lec 12, Lab 1	1, 2, 3, 4
PEK_U01 (skills)	K2MST_U04, K2MST_U05, K2MST_U16, K2MST_mic_U01 K2MST_ mso _U01	C1, C2, C3	Lec 1	1
PEK_U02	K2MST_U06, K2MST_U09 K2MST_U17 K2MST_mic_U02 K2MST_ mso _U02	C1, C2, C3	Lec 1 - Lec 6, Lab 1	1, 2, 3
PEK_U03	K2MST_U24 K2MST_U25 K2MST_mic_U03 K2MST_ mso _U03	C1, C2, C3	Lec 7 – Lec 12, Lab 1	1, 2, 3
PEK_K01 (competences)	K2MST_K05, K2MST_K06 K2MST_mic_K01 K2MST_ mso _K01	C1, C2, C3	Lec 1- Lec 12, Lab 1	1, 2, 3, 4
PEK_K02	K2MST_K03, K2MST_K04 K2MST_mic_K02 K2MST_ mso _K02	C1, C2, C3	Lec 1- Lec 12, Lab 1	1, 2, 3, 4

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