FACULTY OF PURE AND APPLIED MATHEMATICS
SUBJECT CARD

Name of subject in Polish METODY NIELINIOWE
Name of subject in English NONLINEAR METHODS
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
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	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. Student has knowledge of concepts, theorems and methods of mathematical analysis

2. Student has knowledge of concepts and methods of differential equations

\

SUBJECT OBJECTIVES

C1 Study basic concepts and nonlinear methods used in applications

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 has advanced knowledge concerning nonlinear methods
PEU_W02 knows numerical methods applied for approximate solving of mathematical problems in applied sciences
relating to skills:
PEU_U01 is able to construct mathematical models in advanced applications of mathematics
relating to social competences:

PEU_K01 can, without assistance, search for necessary information in the literature, also in foreign languages

PROGRAMME CONTENT		
Lecture		**Number of hours**
Lec 1	Examples of nonlinear phenomena	2
Lec 2	Examples of nonlinear phenomena	2
Lec 3	Nonlinear oscillators	2
Lec 4	Bifurcation and stability	2
Lec 5	Van der Pol equation	2
Lec 6	Duffig equation	2
Lec 7	2-D systems of nonlinear equations – equilibrium points	2
Lec 8	Classification of the equilibrium points	2
Lec 9	Systems of nonlinear equations - attractors	2
Lec 10	Lorenc equation	2
Lec 11	Strange attractors	2
Lec 12	Belolusov-Zabotynski equation	2
Lec 13	Benard cells – equations of hydrodynamics	2
Lec 14	Examples of nonlinear optimisation	2
Lec 15	Some methods of nonlinear optimisation	2
	Total hours	**30**

Laboratory		**Number of hours**
Lab 1	Solving of problems illustrating theory given in the lectures by analytic methods and with MATLAB	30
	Total hours	**30**

TEACHING TOOLS USED
N1. Lecture – traditional method N2. Laboratory- solving problems with computers N3. Consultations N4. Student's self work – preparation for the laboratory

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during	Learning outcomes code	Way of evaluating learning outcomes achievement

semester), P – concluding (at semester end)		
F1	PEU_W01 PEU_W02	test
F2	PEU_U01 PEU_K01	oral answers, calculus trainings, presentations, short tests, tests
P==0.5*F1+0.5*F2		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] D.W. Jordan, P. Smith, Nonlinear Ordinary Differential Equations [2] G. Nicolis, Introduction to Nonlinear Science. **SECONDARY LITERATURE:** [1] D. P. Bertsekas, Nonlinear Programming
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
Prof. dr hab. Wojciech Okrasiński (Wojciech.Okrasinski@pwr.edu.pl)