Zał. nr 5 do ZW 16/2020

FACULTY OF PURE AND APPLIED MATHEMATICS

SUBJECT CARD

Name of subject in Polish Teoria optymalizacji
Name of subject in English Optimization Theory
Main field of study (if applicable): Applied Mathematics
Specialization (if applicable): MODELLING, SIMULATION, OPTIMIZATION
Profile: academic / ~~practical~~*
Level and form of studies: ~~1st~~/ 2nd level, ~~uniform magister studies~~*, full-time / ~~part-time~~*
Kind of subject: obligatory / ~~optional~~ / ~~university-wide~~*
Subject code MAT001588
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	90			
Form of crediting	Examination / ~~crediting with grade~~*				
For group of courses mark (X) final course	X				
Number of ECTS points	3	3			
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. Algebra, Mathematical analysis

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SUBJECT OBJECTIVES

C1 Student is understanding the concepts and methods of mathematical programming.
C2 He knows and understands the formulation of the linear and quadratic programming.
C3 He has knowledge of the theoretical background of mathematical programming.
C4 He knows the computer methods of mathematical programming.
C5 He is able to apply the acquired knowledge to create and analyze mathematical models to solve theoretical and practical study in various fields of science and technology.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge:
PEU_W01 Student knows the formulation of mathematical programming problems.
PEU_W02 He has a basic knowledge about the usage and importance of mathematical programming methods.
PEU_W03 He knows the limitations of analytical methods and the possibility of numerical analysis of optimization problems.
relating to skills:
PEU_U01 Student is able to formulate mathematical programming problem in a convenient

form for analysis. PEU_U02 He can use the appropriate algorithm to solve tasks in the mathematical programming. PEU_U03 He can apply optimization methods, and analytical methods or numerical analysis, in order to solve practical problems. relating to social competences: PEU_K01 The student is able to find and use the recommended literature course and independently acquire knowledge. PEU_K02 The student is able to use the basic tools for the analysis of mathematical models. PEU_K03 The student understands the need for systematic and independent work on mastery of course material.

PROGRAMME CONTENT

	Lecture	Number of hours
Lec 1	Introduction to mathematical programming. Optimization without constraints. Global and local extremes. Optimality conditions.	2
Lec 2	Gradient methods. Steepest descent method. Newton's method and its variants. Analysis of convergence.	6
Lec 3	Linear programming. Geometric interpretation. Simplex algorithm.	4
Lec 4	Dual problem. Duality theory for linear programming. Sensitivity analysis.	2
Lec 5	Integer programming. Linear programming relaxation. Branch and bound method.	2
Lec 6	The theory of Lagrange multipliers. The necessary and sufficient conditions for extreme for constraints in the equality form. Lagrange multipliers in sensitivity analysis.	2
Lec 7	Constraints in the form of inequality. Optimality conditions of Karush-Kuhn-Tucker.	2
Lec 8	Quadratic programming.	2
Lec 9	Quadratic penalty function method. The method of multipliers.	2
Lec 10	Optimization on a convex set. Frank-Wolfe’s method. Gradient projection method. Barrier method,	4
Lec 11	Convex programming. Duality for convex programming. Subgradient. Subgradient methods.	2
	Total hours	30

	Classes	Number of hours
Cl 1	Necessary and sufficient optimality conditions.	4
Cl 2	Properties of convex functions and convex sets.	2
Cl 3	Illustration of gradient methods.	4
Cl 4	Simplex method. Practical applications of linear programming. Sensitivity analysis.	6
Cl 5	Branch and bound method. Practical applications of integer programming.	4
Cl 6	Applications of Lagrange multiplier theory in practical optimization problems.	6
Cl 7	General constrained optimization algorithms.	4
	Total hours	30

Laboratory		Number of hours
Lab 1		
Lab 2		
Lab 3		
Lab 4		
Lab 5		
…		
	Total hours	

Project		Number of hours
Proj 1		
Proj 2		
Proj 3		
Proj 4		
…		
	Total hours	

Seminar		Number of hours
Semin 1		
Semin 2		
Semin 3		
…		
	Total hours	

TEACHING TOOLS USED
N1. Lecture - traditional method. N2. Exercise and accounting problems - the traditional method. N3. Computer-assisted homeworks. N4. Student's own work - preparing to exercise and test.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT

Evaluation (F – forming during semester), P – concluding (at semester end)	Learning outcomes code	Way of evaluating learning outcomes achievement
F1	PEU_W01, PEU_W02, PEU_W03, PEU_K01, PEU_K02	oral presentations, quizzes, homeworks
F2	PEU_W01, PEU_W02, PEU_W03, PEU_U01, PEU_U02, PEU_U03, PEU_K01, PEU_K02, PEU_K03	exam
P=0,4*F1+0,6*F2		

PRIMARY AND SECONDARY LITERATURE
PRIMARY LITERATURE: [1] D.P. Bertsekas, Nonlinear Programming, Athena Scientific, Belmont, MA: 1999. [2] S.P. Bradley, A.C. Hax, T.L. Magnanti, Applied Mathematical Programming, Addison-Wesley Publishing Company, 1977. [3] A. Cegielski, Programowanie matematyczne cz.. 1. Programowanie liniowe, Wydawnictwo Uniwersytetu Zielonogórskiego, 2002 [4] A. Antoniou, W.-S. Lu, Practical Optimization, Springer Science+Business Media, LLC, 2007. **SECONDARY LITERATURE:** [1] S. Boyd, L. Vanderberghe, Convex Optimization, Cambridge University Press, 2004. [2] I. Nykowski, Programowanie liniowe, PWE Warszawa 1980. [3] W. Grabowski, Programowanie matematyczne, PWE Warszawa 1980. [4] R.S. Garfinkel, G.L. Nemhauser, Programowanie całkowitoliczbowe, PWN, 1978. [5] D.P. Bertsekas, A. Nedic, A.E. Ozdaglar, Convex Analysis and Optimization, Athena Scientific, Belmont, MA: 2003. [6] A. Ruszczyński, Nonlinear optimization, Princeton University Press, Princeton, NJ, 2006.
SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)
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