Zał. nr 4 do ZW 64/2012

FACULTY OF PURE AND APPLIED MATHEMATICS

SUBJECT CARD

Name in Polish: Badania Operacyjne
Name in English: Operations Research
Main field of study (if applicable): APPLIED MATHEMATICS
Specialization (if applicable): MODELLING, SIMULATION, OPTIMIZATION
Level and form of studies: ~~1st/~~ 2nd* level, full-time / ~~part-time~~*
Kind of subject: ~~obligatory~~ / optional / ~~university-wide~~*
Subject code MAT001585
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	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	1		3		
including number of ECTS points for direct teacher-student contact (BK) classes	3				

*delete as applicable

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Student knows and can apply basic notions of linear algebra and logic.
2. Student knows basics of computer programming.

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SUBJECT OBJECTIVES

C1 Learning of basic mathematical models supporting decision-making.
C2 Learning of basic algorithms used in operations research
C3 Acquisition of abilities in constructing mathematical models for real problems.
C4 Acquisition of abilities in implementing models in a mathematical modeling language
C5 Acquisition of abilities in presenting and interpreting solutions of the constructed models.

SUBJECT EDUCATIONAL EFFECTS

relating to knowledge the student:
PEK_W01 has in-depth knowledge of linear programming
PEK_W02 knows basic models and algorithms used in operations research.

relating to skills the student:
PEK_U01 can build mathematical models for real problems
PEK_U02 can implement mathematical models using a mathematical modeling language

relating to social competences the student:
PEK_K01 can present problem solutions to non-mathematicians in an understandable way.

PROGRAMME CONTENT

Form of classes - lecture		**Number of hours**
Lec1	Introduction to operations research. Formulation of the linear programming problem	2
Lec2	Building mathematical models (1)	2
Lec3	Building mathematical models (2)	2
Lec4	Building mathematical models (3)	2
Lec5	The simplex algorithm for linear programming.	2
Lec6	Duality and sensitivity analysis in linear programming	2
Lec7	Algorithms for integer linear programming.	2
Lec8	Minimum cost flow problem – applications and mathematical properties	2
Lec9	Network simplex algorithm	2
Lec10	The shortest (longest) path problem – applications and algorithms	2
Lec11	The maximum flow problem – applications and algorithms	2
Lec12	The assignment, minimum spanning tree and traveling salesperson problems – applications and algorithms	2
Lec13	Elements of computational complexity, NP-hard combinatorial optimization problems and limitations of modern computational techniques.	2
Lec14	Multiobjective programming	2
Lec15	Written test	
	Total hours	**30**

Form of classes - Class		**Number of hours**
La1	Introduction to MathProg (AMPL) language	2
La2	Building and implementing linear programming models for chosen problems	4
La3	Building and implementing integer linear programming models for chosen problems	8

La4	Building and implementing models for the minimum cost flow problem and its variants	4
La5	Building and implementing models for various variants of the traveling salesperson problem	2
La6	Building and implementation models for chosen combinatorial optimization problems	4
La7	Building and implementing models for chosen multiobjective problems	4
La8	Written test	2
	Total hours	**30**

TEACHING TOOLS USED

N1. Lecture – computer presentation and traditional method
N2. Laboratory – building models for chosen problems and implementation of the models using the AMPL language

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_W01 PEK_W02	Written test (lecture)
F2	PEK_U01 PEK_U02 PEK_K01	Written test (laboratory)
P=0.5*F1+0.5*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] H. A. Taha. Operations research. An introduction. Pearson Eduction 2007.
[2] F.S. Hillier, G. J. Lieberman. Introduction to operations research. Mc. Graw Hill 2001.
[3] B. Kolman, R.E. Beck. Elementary linear programming with applications. Elsevier Science 1995.

SECONDARY LITERATURE:

[4] A. Shrijver. Theory of linear and integer programming. J. Wiley & Sons 1999.
[5] M.S. Bazaraa, J. J. Jarvis, H. D. Sherali. Linear programming and network flows. J. Wiley & Sons 2010.
[6] R. Ahuja, T. Magnanti, J. Orlin. Network flows. Theory algorithms and applications. Prentice Hall 1993.
[7] R. Fourer, D.M. Gay, B.W. Kernighan. AMPL. A modeling language for mathematical programming, free e-book: *http://ampl.com/resources/the-ampl-book/chapter-downloads/*

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT
OPERATIONS RESEARCH MAT001585
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY APPLIED MATHEMATICS AND SPECIALIZATION
MODELLING, SIMULATION, OPTIMIZATION

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)**	Subject objectives***	Programme content***	Teaching tool number***
PEK_W01 (knowledge)	K2MST_W04 K2MST_W08, K2MST_mso_W01	C1, C2	Lec5-Lec14	1
PEK_W02	K2MST_W11, K2MST_W21 K2MST_mso_W02 K2MST_mso_W03	C1, C2	Lec1-Lec4 Lec8-Lec12	1
PEK_U01 (skills)	K2MST_U10 K2MST_U15, K2MST_mso_U01	C3, C4	Lec1-Lec4 La1-La8	1,2
PEK_U02	K2MST_U24 K2MST_U25 K2MST_mso_U02 K2MST_mso_U03	C3, C4	La1-La8	2
PEK_K01 (competences)	K2MST_K05 K2MST_mso_K01 K2MST_mso_K02	C5	La1-La8	2

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