# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Operational Research [S1Inf1>BOP]

## Course

Field of study
Computing

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

## Number of hours

Lecture
24

Laboratory classes
0

Other (e.g. online)
0

Tutorials
24

Projects/seminars
0

## Number of credit points

4,00

## Coordinators

prof. dr hab. inż. Joanna Józefowska
joanna.jozefowska@put.poznan.pl

## Lecturers

## Prerequisites

Basic knowledge in algebra, calculus, probability theory, statistics and computational complexity. Student should be able to perform basic matrix operations, alculate derivatives and find extremes of a given real function, calculate conditional and total probability, estimate computational complexity of an algorithm and problem, acquire information from literature. Student should understand the need to extend his/her competences.

## Course objective

1. Provide students knowledge regarding models and methods of operational research, related in particular to scheduling in computer and management systems. 2. Develop students' skills in solving problems related to modelling and solving simple problems in continuous and discrete optimization. 3. Develop students' skills in analysis and modelling of decision problems. Course - related learning outcomes Knowledge Students acquire knowledge in mathematics and mathematical modelling, solving complex optimization tasks using mathematical models and optimization methods; have wide and in - depth knowledge necessary to understand and effectively apply quantitative decisionsupport methods, be informed about trends and advances in operational research, in particular optimization methods and techniques. Skills Students are able to acquire, integrate, interpret and evaluate information from literature, databases and WWW sources on optimization methods and techniques, are able to plan and arrange self - education process in particular covering issues of operational research, are able to apply mathematical models and optimization algorithms in decision support tasks, are able to integrate knowledge coming both from different sub - domains of computer sciences and operational reserach to formulate and solve engineering tasks, are able to use available software to solve simpleoptimization problems, are able to evaluate strong and weak points of algorithms and their implementation and asses their usefulness to IT tasks. Social competences Upon completion of the course the student will develop the following attitudes: understands that knowledge and skills related to computer science and operational research quickly become insufficient, knows examples / case studies in quantitative decision support and understands their limitations, is able to correctly assign priorities to own tasks.

## Course-related learning outcomes

empty

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Formative assessment:
a) lectures: based on answers to question in two online test,
b) tutorials: evaluation of doing correctly assigned tasks and two online tests,
Total assessment:
a) verification of assumed learning objectives related to lectures: evaluation of acquired knowledge on the basis of two online tests; discussion of correct answers in the test;
b) verification of assumed learning objectives related to tutorials: monitoring students' activities during classes, two online colloquia during the classes,
Additional elements cover: discussing more general and related aspects of the class topic, suggesting how to improve the instructions and teaching materials.

## Programme content

Lecture: Scope and methods of Operational Research. Classification of decision models. Linear programming: problem formulation and computational complexity,simplex method, dual problem (formulation, properties and interpretation). Non - linear programming: Lagrange conditions and method, Karush - Kuhn - Tucker theorems and method, gradient and non - gradient methods of solving NLP problems. Discrete optimization: Gomory"s cutting plane method, local search algorithms. Deterministic scheduling: basic assumptions, classification and examples of problems and solutions. Project scheduling: PERT, CPM and CPM - MCX methods, classification of resources, definition of RCSP. Introduction to Game
Theory: zero - sum games, games against nature.
Tutorials: Formulation of decision problems as mathematical programming models. Solving PL problems with simplex. Finding initial basic solution. Fomulation, solving and interpretation of dual LP problem. Analytical methods of solving NLP problems: Langrange and KKT. Gomory"s cutting plane method.Project scheduling with CPM, PERT and CPM - MCX methods. Solving zero - sum games.

## Teaching methods

Lecture: multimedia presentation, presentation illustrated with examples presented on black board, solving tasks, multimedia show - case

Tutorials: solving tasks, practical exercises, discussion, teamwork, multimedia showcase

## Bibliography

Basic
1. J. Józefowska, Badania operacyjne i teoria optymalizacji, Wyd. Politechniki Poznańskiej 2012.
2. M. Siudak. Badania operacyjne. Oficyna Wydawnicza PolitechnikiWarszawskiej, Warszawa, 1994.
3. Badania operacyjne, Ignasiak E.(red.), PWE, Warszawa, 1996
4. Badania operacyjne w przykładach i zadaniach, Jędrzejczak Z., Skrzypek J., Kukuła K., Walkost Anna, PWN, Wyd. IV zmienione, Warszawa, 2002
Additional
1. Handbook on Scheduling : From Theory to Applications, BłażewiczJ.i inni, Springer, Berlin, 2007
2. Introduction to Operations Research, Hillier F. S., Lieberman G. J.,McGraw ‑ Hill, New York, 1990
3. J.G. Ecker, M. Kupferschmid. Introduction to Operations Research.John Wiley & Sons, New York, 1988.
4. P. D. Straffin. Teoria Gier. WN Scholar, Warszawa, 2001.
5. T. Trzaskalik. Wprowadzenie do badań operacyjnych z komputerem. Polskie Wydawnictwo Ekonomiczne, Warszawa, 2003.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 100 | 4,00 |
| Classes requiring direct contact with the teacher | 48 | 2,00 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 52 | 2,00 |