

## SYLLABUS OF A MODULE

Polish name of a module	<b>Optymalizacja w projektowaniu inżynierskim</b>
English name of a module	<b>Optimisation in engineering design</b>
ISCED classification - Code	0713
ISCED classification - Field of study	0713
Languages of instruction	<i>English</i>
Level of qualification:	<b>1 – BSc (EQF 6)</b>
Number of ECTS credit points	6
Examination:	A
Available in semester:	Y

### Number of hours per semester:

Lecture	Exercises	Laboratory	Seminar	E-learning	Project
30	0	30	0	0	0

### MODULE DESCRIPTION

#### MODULE OBJECTIVES

- O1. To get knowledge on fundamentals of optimisation methods together with their application to engineering design problems.
- O2. To develop skills of application of optimisation methods in practical problems.

#### PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

- 1. Fundamentals of calculus
- 2. Knowledge of vector calculus and linear algebra.
- 3. Capability of using of source literature.
- 4. Ability of individual work and collaboration in a group.

## LEARNING OUTCOMES

LO 1 – Knowledge on optimisation methods in engineering design

LO 2 – Capability of using of optimisation methods in engineering desing

LO 3 – Capability of interpretation and analysis of research results

## MODULE CONTENT

Type of classes – Lecture	Number of hours
<b>Lec 1-2</b> - Introduction to optimisation in engineering design. Fundamental concepts in optimisation and optimisation methods.	2
<b>Lec 3-6</b> – Introduction to numerical tools for solution of optimisation problems. AMPL.	4
<b>Lec 7-8</b> - Direct methods and “black box” optimisation. One-dimensional elimination methods.	2
<b>Lec 9-12</b> - Nelder-Mead method and its applications.	4
<b>Lec 13-16</b> - Application of direct methods to optimisation of power plants and thermal cycles.	4
<b>Lec 17-20</b> - Multiobjective optimisation. Pareto optimality.	4
<b>Lec 21-24</b> - Computational fluid dynamics in optimisation (CFD-O).	4
<b>Lec 25-26</b> - Application of CFD-O to the design of wind turbines.	2
<b>Lec 27-30</b> – Artificial neural networks and genetic algorithms in optimisation.	4
<b>Sum</b>	<b>30</b>
Type of classes– Laboratory	Number of hours
<b>Lab 1-2</b> - Formulation of engineering design problems as optimisation problems.	1
<b>Lab 3-4</b> – Application of AMPL to optimisation problems.	4
<b>Lab 5-6</b> – Introduction to numerical tools for optimisation problems.	3
<b>Lab 7-8</b> – Application of elimination methods to optimisation of thermal systems.	3

<b>Lab 9-10</b> – Application of Nelder-Mead method to optimisation of thermal systems.	<b>4</b>
<b>Lab 11-12</b> – Optimisation of multi-stage compressors with AMPL.	<b>4</b>
<b>Lab 13-14</b> – Optimisation of heat exchangers with AMPL.	<b>3</b>
<b>Lab 15</b> – Multiobjective optimisation of heat exchangers.	<b>4</b>
<b>Lab 15</b> – Optimisation of systems with a solar collector.	<b>4</b>
<b>Sum</b>	<b>30</b>

## TEACHING TOOLS

1 - Lecture notes
2 – AMPL Manual
3 - PC workstations with the optimisation and design software (AMPL, C++, Octave)

## WAYS OF ASSESSMENT ( F – FORMATIVE, S – SUMMATIVE

<b>F1.</b> - assessment of preparation for laboratory exercises
<b>F2.</b> - assessment of the ability to apply the acquired knowledge while doing the exercises
<b>F3.</b> - evaluation of reports on the implementation of exercises covered by the curriculum
<b>F4.</b> - assessment of activity during classes
<b>S1.</b> - assessment of the ability to solve the problems posed and the manner of presentation of the obtained results - pass mark *
<b>S2.</b> - assessment of mastery of the teaching material – the final practical problem

\*) in order to receive a credit for the module, the student is obliged to attain a passing grade in all laboratory classes as well as in achievement tests.

## STUDENT'S WORKLOAD

L.p.	Forms of activity	Average number of hours required for realization of activity
<b>1. Contact hours with teacher</b>		
1.1	Lectures	30

1.2	Tutorials	0
1.3	Laboratory	30
1.4	Seminar	0
1.5	Project	0
1.6	Examination	0
Total number of contact hours with teacher:		60
<b>2. Student's individual work</b>		
2.1	Preparation for tutorials and tests	20
2.2	Preparation for laboratory exercises, writing reports on laboratories	20
2.3	Preparation of project	0
2.4	Preparation for final lecture assessment	0
2.5	Preparation for the final test	20
2.6	Individual study of literature	30
Total number of hours of student's individual work:		90
Overall student's workload:		150
<b>Overall number of ECTS credits for the module</b>		6 ECTS
Number of ECTS points that student receives in classes requiring teacher's supervision:		2.4 ECTS
Number of <b>ECTS</b> credits acquired during practical classes including laboratory exercises and projects:		2.0 ECTS

#### **BASIC AND SUPPLEMENTARY RESOURCE MATERIALS**

1. Rao S.: Engineering optimization. A Wiley-Interscience Publication John & Sons, Inc. New York 1996
2. Baldick R.: Applied optimization. Cambridge University Press. 2006
3. Gill P.E.: Practical optimization. Academic Press, New York, 2000
4. Thevenin D.: Optimization and computational fluid dynamics. Springer-Verlag, 2008
5. Fourer R. et al: The AMPL book. AMPL Optimization Inc. 2003

#### **MODULE COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)**

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