SYLLABUS OF A MODULE

Polish name of a module	**Optymalizacja w projektowaniu inżynierskim**
English name of a module	**Optimisation in engineering design**
ISCED classification - Code	0713
ISCED classification - Field of study	0713
Languages of instruction	*English*
Level of qualification:	***1 – BSc (EQF 6)***
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**
Lec 1-2 - Introduction to optimisation in engineering design. Fundamental concepts in optimisation and optimisation methods.	**2**
Lec 3-6 – Introduction to numerical tools for solution of optimisation problems. AMPL.	**4**
Lec 7-8 - Direct methods and “black box” optimisation. One-dimensional elimination methods.	**2**
Lec 9-12 - Nelder-Mead method and its applications.	**4**
Lec 13-16 - Application of direct methods to optimisation of power plants and thermal cycles.	**4**
Lec 17-20 - Multiobjective optimisation. Pareto optimality.	**4**
Lec 21-24 - Computational fluid dynamics in optimisation (CFD-O).	**4**
Lec 25-26 - Application of CFD-O to the design of wind turbines.	**2**
Lec 27-30 – Artificial neural networks and genetic algorithms in optimisation.	**4**
Sum	**30**
Type of classes– Laboratory	**Number of hours**
Lab 1-2 - Formulation of engineering design problems as optimisation problems.	**1**
Lab 3-4 – Application of AMPL to optimisation problems.	**4**
Lab 5-6 – Introduction to numerical tools for optimisation problems.	**3**
Lab 7-8 – Application of elimination methods to optimisation of thermal systems.	**3**

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

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

F1. - assessment of preparation for laboratory exercises
F2. - assessment of the ability to apply the acquired knowledge while doing the exercises
F3. - evaluation of reports on the implementation of exercises covered by the curriculum
F4. - assessment of activity during classes
S1. - assessment of the ability to solve the problems posed and the manner of presentation of the obtained results - pass mark *
S2. - 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**
1. Contact hours with teacher		
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
2. Student's individual work		
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
Overall number of ECTS credits for the module		6 ECTS
Number of ECTS points that student receives in classes requiring teacher's supervision:		2.4 ECTS
Number of **ECTS** 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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