# SYLLABUS OF A MODULE

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|---|---|
| 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

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| 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

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| **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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