# METHODS OF OPTIMIZATION

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| **Faculty of Computer Science** | | | | |
| Study programme: | **Computer Science** | | Degree level: | **Engineer's degree full-time programme** |
| Specialization | **---** | | Diploma path: | **2026/2027W - 2026/2027S** |
| Module name: | **Methods of Optimization**<br>( Metody optymalizacji) | | | |
| Module type: | **obligatory** | **Semester: 2** | ECTS:**5** | Module ID:**FCS-00022** |
| No. of hrs in semester: | Lecture (L) - **30** Classes(C) - **15** Specialization workshop (SW) - **15** Project (P) - **0** Laboratory classes (LC) - **0** Seminar (S) - **0** | | | |
| Prerequisites | - | | | |

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| Aims and objectives: | Getting students to learn basic terminology of optimization theory and methods of solving optimization problems of various types. Gaining ability to solve selected types of optimization problems. | | |
| Forms of teching activities:: | lecture, classes, specialization workshop, | Assessment: | Evaluation must be relevant to the intended learning outcomes: |
| | | written exam, written in-class tests, evaluation of exercises completion | |
| Module content: | 1. Linear programming: simplex method, duality.<br>2. Nonlinear programming: necessary and sufficient optimality conditions for problems without constraints; gradient methods for optimizations without constraints; non-gradient methods for optimizations without constraints; necessary and sufficient optimality conditions for problems with constraints; duality; constrained optimization methods.<br>3. Calculus of variations: the fundamental problem of the calculus of variations, the Euler—Lagrange equation; variational problems with several variables, the isoperometric problem; the Lagrange problem.<br>4. Optimal control: formulation of the problem and the Pontryagin Maximum Principle. | | |
| Teaching methods: | laboratory exercises, subject exercises, programming, informative lecture, | | |

**Learning outcomes**

| Symbol | Specify min. 4, max. 8 learning outcomes in the following order: knowledge – skills – competence. Each learning outcome must be verifiable | Reference to the programme learning outcomes of education |
|---|---|---|
| LO1 | has a theoretical knowledge on optimization theory and methods which allows to analyze and to model data and real world processes | |
| LO2 | knows the standard procedures in the optimization, including software for solving optimization problems | |
| LO3 | is able to use knowledge from various areas of mathematics in solving optimization problems | |
| LO4 | formulates various optimization problems; is able to choose a suitable method to solve optimization problems; is able to solve himself using software a simple optimization problem; | |

| No. of learning outcome | Methods of assessing the learning outcome | Type of teaching activities (if more than one) during which the outcome is assessed |
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| LO1 | written exam | L |
| LO2 | written exam | L |
| LO3 | written in-class tests | SW |
| LO4 | evaluation of exercises completion, written in-class tests | SW |

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| Student's workload (in hours) | **1** - Attendance at lectures | None | 30 |
| | **2** - Attendance at classes and specialistic workshop | | 30 |
| | **3** - Reports from the workshop and completion of homework | None | 20 |
| | **4** - Preparing for exercises, laboratory tests and in-class tests | None | 29 |
| | **5** - Participation in student-teacher sessions | None | 4 |
| | **6** - Preparation for exam | None | 10 |
| | **7** - Presence during exam | | 2 |
| | | **TOTAL:** | **125** |

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| Quantitative indicators | Student's workload - activities that require direct teacher participation:<br>(5)+(1)+(2)+(7) | 66 | **ECTS** |
| | | | 2.6 |
| | Student's workload connected with practical classes<br>(2)+(3)+(4) | 79 | 3.2 |

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| Basic references: | 1. A. Ruszczyński, Nonlinear optimization, Princeton, Oxford:Princeton University Press, 2006.<br>2. D. G. Luenberger, Linear and Nonlinear Programming, Reading, Massachusetts : Addison-Wesley Publ., 1984.<br>3. I. M. Gelfad, S. V. Fomin, Calculus of Variations, Courier Dover Publications, 2000. |
| Further reading | 1. Donald E. Kirk, Optimal control theory : an introduction / Englewood Cliffs : Prentice-Hall, 1970.<br>2. B.C. Chachuat, Nonlinear and dynamic optimization: From Theory to Practice, Ecole Polytechnique Federale de Lausanne, IC-32: Winter Semester 2006/2007, https://infoscience.epfl.ch/record/111939/files/Chachuat_07(IC32).pdf |

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| Unit: | Software Department | Lecturer/ instructor | |
| Date of issuing the programme: | 31st March 2026 | Author of the programme: | dr inż. Magdalena Topczewska |

L - lecture, C - classes, LC - laboratory classes, P-project, SW - specialization workshop, S - seminar