1. **Course title:** OPTIMIZATION THEORY

2. **Course code**

3. **Validity of course description:** 2016/2017

4. **Level of studies:** MSc programme

5. **Mode of studies:** intramural studies

6. **Field of study:** MACROCURSE (FACULTY SYMBOL) RAU0

7. **Profile of studies:** general

8. **Programme:** Automatic Control, Electronic and Computer Science

9. **Semester:** 1

10. **Faculty teaching the course:** Institute of Automatic Control, Rau1

11. **Course instructor:** Adam Gałuszka

12. **Course classification:** programme courses

13. **Course status:** compulsory

14. **Language of instruction:** English

15. **Pre-requisite qualifications:** Optimization and Decision Making. It is assumed that students have knowledge of necessary and sufficient conditions for optimality, unconstrained and constrained problems, Lagrange functional, Kuhn-Tucker conditions, Linear programming, Simplex method, gradient methods.

16. **Course objectives:** Introduction to advanced mathematical optimization methods and algorithms, optimal control problems. Development of skills necessary to implement and solve complex optimization problems.

17. **Description of learning outcomes:**

<table>
<thead>
<tr>
<th>Nr</th>
<th>Learning outcomes description</th>
<th>Method of assessment</th>
<th>Teaching methods</th>
<th>Learning outcomes reference code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>He knows the basic methods of dynamic optimization.</td>
<td>SP</td>
<td>WM</td>
<td>K_W01</td>
</tr>
<tr>
<td>2.</td>
<td>He has knowledge of integer programming methods.</td>
<td>SP</td>
<td>WM</td>
<td>K_W01</td>
</tr>
<tr>
<td>3.</td>
<td>He has knowledge of multi-criteria optimization methods and evolutionary optimization methods.</td>
<td>SP</td>
<td>WM</td>
<td>K_W01</td>
</tr>
<tr>
<td>4.</td>
<td>He has the ability to implement and solve the problem of dynamic optimization.</td>
<td>SP, CL</td>
<td>L</td>
<td>K_U07</td>
</tr>
<tr>
<td>5.</td>
<td>Has the ability to implement and solve the problem of multi-criteria optimization.</td>
<td>SP, CL</td>
<td>L</td>
<td>K_U21</td>
</tr>
<tr>
<td>6.</td>
<td>Can use the knowledge gained to make optimal decisions in professional practice.</td>
<td>OS</td>
<td>L</td>
<td>K_K04</td>
</tr>
</tbody>
</table>

18. **Teaching modes and hours**

* Lecture / Laboratory

Sem 1 - 60 h

19. **Syllabus description:**

Lecture:
- duality in linear programming
- integer and binary integer programming,
- mixed integer problems,
- branch and bound method,
- computational complexity and NP-completeness,
- non-linear constraints and unconstrained optimization,
- evolutionary algorithms,
- multi-criteria optimization, pareto-optimality
- discrete and continuous dynamical optimization problems,
Laboratory:
1. Integer and binary integer linear programming
2. Decision trees
3. Genetic algorithms
4. Direct methods of unconstrained dynamic optimization
5. Constrained dynamic optimization (penalty methods)
6. Linear Quadratic problem
7. Optimal control
8. Optimization in graph problems

20. Examination: semester …

21. Primary sources:

22. Secondary sources:
Luenberger D.: Introduction to linear and nonlinear programming, Adison-Wesley, 1973
Bryson A., Y.C. Ho: Applied optimal control, Blaisdell, 1969

23. Total workload required to achieve learning outcomes

<table>
<thead>
<tr>
<th>Lp.</th>
<th>Teaching mode</th>
<th>Contact hours / Student workload hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lecture</td>
<td>30/20</td>
</tr>
<tr>
<td>2</td>
<td>Classes</td>
<td>0/0</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory</td>
<td>30/20</td>
</tr>
<tr>
<td>4</td>
<td>Project</td>
<td>0/0</td>
</tr>
<tr>
<td>5</td>
<td>BA/ MA Seminar</td>
<td>0/0</td>
</tr>
<tr>
<td>6</td>
<td>Other</td>
<td>10/10</td>
</tr>
<tr>
<td></td>
<td>Total number of hours</td>
<td>70/50</td>
</tr>
</tbody>
</table>

24. Total hours: 60

25. Number of ECTS credits: 4

26. Number of ECTS credits allocated for contact hours: 2

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 2

26. Comments:

Approved:

(date, Instructor’s signature)          (date, the Director of the Faculty Unit signature)