1. **Course title:** SOFT COMPUTING, Fuzzy data analysis
2. **Course code:** SC_FDA

3. **Validity of course description:** 2018/2019

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

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

6. **Field of study:** CONTROL, ELECTRONIC AND INFORMATION ENGINEERING (MACRO) (FACULTY SYMBOL) RAU-2

7. **Profile of studies:** ACADEMIC

8. **Programme:** DATA SCIENCE

9. **Semester:** 1

10. **Faculty teaching the course:** Faculty of Automatic Control, Electronics and Computer Science

11. **Course instructor:** Dr inż. Adam Gudyś

12. **Course classification:** common courses

13. **Course status:** compulsory/elective

14. **Language of instruction:** English

15. **Pre-requisite qualifications:** Computer programming, Optimization methods, Numerical methods, Statistics and probability theory, Algorithms and data structures.

16. **Course objectives:** The aim of the course is making students familiar with modeling, classification and generally data analyses based of formalisms of fuzzy sets theory. Data analysis scenarios, based on fuzzy sets are illustrated by many applications, in biomedicine, engineering, automatic control, electronics, informatics.

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>Student understands basic notions of fuzzy set, interval set, t-norm.</td>
<td>Credit</td>
<td>Lecture</td>
<td>K2A_W01, K2A_W02</td>
</tr>
<tr>
<td>2</td>
<td>Student is able to relate problems of modeling uncertainty in concrete cases to the formalisms of fuzzy sets.</td>
<td>Credit</td>
<td>Lecture</td>
<td>K2A_W04, K2A_W07</td>
</tr>
<tr>
<td>3</td>
<td>Student is able to relate basic notions of Dempster-Shafer theory to representation of knowledge extracted from data.</td>
<td>Credit</td>
<td>Lecture</td>
<td>K2A_W08, K2A_W10</td>
</tr>
<tr>
<td>4</td>
<td>Student is able to create membership function represented knowledge and data.</td>
<td>Project tasks</td>
<td>Project</td>
<td>K2A_U08, K2A_U10</td>
</tr>
<tr>
<td>5</td>
<td>Student knows properties of norms, conorms, measures of membership grades and is able to use them for information aggregation.</td>
<td>Project tasks</td>
<td>Project</td>
<td>K2A_U07, K2A_U08</td>
</tr>
</tbody>
</table>
6. Student is able to fit uncertainty measures to the desired tool of computer aided decision.

7. Student is able to extract fuzzy rules from data.

8. Student is able to choose a suitable software tools for construction of systems of computer aided decision making.

9. Project tasks

10. Teaching modes and hours
   Lecture 15 / BA / MA Seminar / Class / Project 15 / Laboratory

11. Syllabus description:
   Lecture:
   1. Introductory issues. Importance of fuzzy data analyses for applications in biomedical engineering, biocybernetics, automatic control, electronics, information technologies.
   2. Theory of sets: fuzzy sets, interval fuzzy sets, intuitionistic sets (t-norms, implications, cardinality of sets)
   3. The Dempster-Shafer theory for fuzzy focal elements (basic definitions, uncertainty vs. imprecision, different concepts of fuzzy focal elements)
   4. Representation of heuristics (medical indexes transformed into computer diagnosis support tools, analysis of medical databases, expert knowledge representation)
   5. Membership functions construction and extraction of fuzzy focal elements based on data
   6. Using fuzzy rules for decision support (diagnosis support using fuzzy sets, interval fuzzy sets, and the Dempster-Shafer theory)
   7. Fuzzy systems and neural networks used for common or diverse solutions.

   Project:
   1. Designing membership functions from data and heuristic knowledge
   2. Suggesting uncertainty and imprecision measures appropriate for practical tasks of decision
   3. Support
   4. Evaluating significance of fuzzy rules
   5. Creating decision support systems

12. Examination: semester NO

13. Primary sources:

14. Secondary sources:
   T.J. Ross, (2010), Fuzzy logic with engineering applications, Wiley
### 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>15/15</td>
</tr>
<tr>
<td>2</td>
<td>Classes</td>
<td>/</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory</td>
<td>/</td>
</tr>
<tr>
<td>4</td>
<td>Project</td>
<td>15/15</td>
</tr>
<tr>
<td>5</td>
<td>BA/MA Seminar</td>
<td>/</td>
</tr>
<tr>
<td>6</td>
<td>Other</td>
<td>/</td>
</tr>
<tr>
<td></td>
<td>Total number of hours</td>
<td>30/30</td>
</tr>
</tbody>
</table>

### 24. Total hours: 60

### 25. Number of ECTS credits: 2

### 26. Number of ECTS credits allocated for contact hours: 1

### 27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 1

### 26. Comments:

Approved:

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