### 1. Course title: Mixed-signal circuits design

### 2. Course code

### 3. Validity of course description: 2013/2014

### 4. Level of studies: BSc programme

### 5. Mode of studies: intramural studies

### 6. Field of study: Macrocourse on Automatic Control and Robotics, Electronics, and Telecommunication, and Computer Science.

(FACULTY SYMBOL): RAU

### 7. Profile of studies: general academic

### 8. Programme: Electronics and Telecommunication

### 9. Semester: 6

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

### 11. Course instructor: dr inż. Jerzy Fiolka

### 12. Course classification: Macrocourse specialization: Electronics and Telecommunication

### 13. Course status: compulsory

### 14. Language of instruction: English

### 15. Pre-requisite qualifications: Course attendants have to possess basic knowledge in algebra, physics, circuit theory, electronic, signal processing, digital circuits. Students are also supposed to possess practical skills concerning design, simulation and construction of electronic systems.

### 16. Course objectives: The main purpose of this course is to provide theoretical and practical knowledge to the students about the design of mixed-signal circuits.

### 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/She knows principles of operation, parameters and characteristics of basic semiconductor devices, analog, digital and mixed circuits.</td>
<td>written test</td>
<td>multimedia lecture</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>He/She knows the basic methods of analysis and designing of a mixed-signal circuits</td>
<td>written test</td>
<td>multimedia lecture</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>He/She can elaborate documentation that includes description of the realization of a project.</td>
<td>project realisation, written report</td>
<td>Project</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>He/She can design and simulate electronic circuits using a computer-aided design tools</td>
<td>project realisation, written report</td>
<td>Lecture, Project</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>He/She can work in a team and take responsibility for a task realized together</td>
<td>project realisation, written report</td>
<td>Project</td>
<td></td>
</tr>
</tbody>
</table>

### 18. Teaching modes and hours

Lecture / BA / MA Seminar / Class / Project / Laboratory

Lecture: 30h, Project: 30h

### 19. Syllabus description:

Lecture:
Mixed signal circuits design lecture covers the following topics:
1) Definitions and basic features of mixed-signal circuits;
2) Hardware and software subsystems of mixed-signal systems;
3) CAD tools for circuits design and simulation;
4) Sampling of continuous-time signals;
5) Operational amplifiers: types, structures, operation, parameters, applications;
6) Analog filters: fundamentals, design, simulation, realizations;
7) A/D converters: types, principle of operation, parameters;
8) D/A converters: types, principle of operation, parameters;
9) Sensor signal conditioning;
10) Phase-locked loop (PLL): principle of operation, parameters, applications;
11) Switched capacitor circuits (SC): principle of operation, parameters, applications;
12) Direct digital synthesis (DDS): principle of operation, parameters, applications;
13) Power supplies: types, structures, simulation, design
14) Interfacing Analog to Digital Circuits;
15) PCB Design for mixed-signal circuits;

Project:
Group of students (max. 3 people) choose project concerning design, simulation, construction and development of a mixed-signal circuit. The final result of the project is a working circuit and documentation.

20. Examination: no

21. Primary sources:

22. Secondary sources:

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>30/10</td>
</tr>
<tr>
<td>2</td>
<td>Classes</td>
<td>0/0</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory</td>
<td>0/0</td>
</tr>
<tr>
<td>4</td>
<td>Project</td>
<td>30/25</td>
</tr>
<tr>
<td>5</td>
<td>BA/ MA Seminar</td>
<td>0/0</td>
</tr>
<tr>
<td>6</td>
<td>Other</td>
<td>5/5</td>
</tr>
<tr>
<td></td>
<td>Total number of hours</td>
<td>65/40</td>
</tr>
</tbody>
</table>

24. Total hours: 105
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)