1. Course title: PRINTED CIRCUIT BOARD DESIGN
2. Course code: PCBDLab
3. Validity of course description: 2013/2014
4. Level of studies: MSc programme
5. Mode of studies: intramural studies
6. Field of study: MAKROKIERUNEK (FACULTY SYMBOL) RAU3
7. Profile of studies: general
8. Programme:
9. Semester: 7
10. Faculty teaching the course: Institute of Electronics (RAu3)
11. Course instructor: Dariusz Wójcik, PhD, Eng
12. Course classification:
13. Course status: elective
14. Language of instruction: English
15. Pre-requisite qualifications: It is assumed that students have mastered the material in the circuit theory, design of analog and digital circuit and design for manufacture.

16. Course objectives: The main goal of the course is to introduce students to fundamental aspect of printed circuit board design techniques using sophisticated EDA tools. The subject matter of the lecture encompasses – among other things – logical system design through schematic capture, constraints driven design, physical design using PCB layout and manufacturing data creation. Some introductory information about printed circuit board routability issues as well as high speed design aspects are provided.

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>can use advanced schematic editor</td>
<td>lab work</td>
<td>laboratory</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>can define constrains for high-speed interconnections</td>
<td>lab work</td>
<td>laboratory</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>can prepare documentation for PCB manufacturing</td>
<td>lab work</td>
<td>laboratory</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>can design PCB taking into account EMC requirements</td>
<td>lab work</td>
<td>laboratory</td>
<td></td>
</tr>
</tbody>
</table>

18. Teaching modes and hours

Lecture / BA / MA Seminar / Class / Project / Laboratory
Laboratory: 30 h

19. Syllabus description:

1. Introduction to Expedition Enterprise Suite
2. Library creation
3. Creation of schematics for advanced designs
4. Constraints driven design
5. Manual and automatic routing design
6. Constraints for high-speed circuits
7. Power planes in multilayer PCB
8. Manufacturing output creation
9. Simulation of signal integrity aspects using HyperLynx

Project
1. Library creation for PCI card design.
2. Creation of schematics.
4. Constraints creation.
5. Pre-layout simulations.
7. Post-layout simulations.
8. Power planes creation.
9. Manufacturing output creation.

20. Examination: none

21. Primary sources:
   - IPC standards (www.ipc.org)
   - Charles Harper, High Performance Printed Circuit Boards, 2005
   - Expedition Enterprise Flow documentation (www.mentor.com)

22. Secondary sources:
   - Archambeault, Bruce R., Drewniak, James, PCB Design For Real-World EMI Control
   - Stephen C. Thierauf, High-Speed Circuit Board Signal Integrity
   - Mark I. Montrose, Printed Circuit Board Design Techniques For EMC Compliance: A Handbook For Designers
   - Mark I. Montrose, EMC And The Printed Circuit Board: Design, Theory, And Layout Made Simple
   - Michel Douglas Brooks, Signal Integrity Issues And Printed Circuit Board Design

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>0/0</td>
</tr>
<tr>
<td>2</td>
<td>Classes</td>
<td>0/0</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory</td>
<td>30/15</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>10/5</td>
</tr>
<tr>
<td></td>
<td>Total number of hours</td>
<td>40/20</td>
</tr>
</tbody>
</table>

24. Total hours: 55

25. Number of ECTS credits: 2

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

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

28. Comments:

Approved:

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