### COURSE DESCRIPTION

1. **Course title:** RADIO FREQUENCY IDENTIFICATION SYSTEMS  
2. **Course code:** RFID

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

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

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

6. **Field of study:** MAKROKIERUNEK  
   *(Faculty symbol) RAU3*

7. **Profile of studies:** general

8. **Programme:**

9. **Semester:**

10. **Faculty teaching the course:** Institute of Electronics (RAU3)

11. **Course instructor:** Tomasz Topa, PhD, Eng

12. **Course classification:**

13. **Course status:** elective

14. **Language of instruction:** English

15. **Pre-requisite qualifications:** principles of electric circuits, computer and digital systems fundamentals, fundamentals of information systems security, fundamentals of access control systems; an understanding of antenna theory and design would be useful but is not necessary, as the basics will be covered on the course.

16. **Course objectives:** The aim of this course is to familiarize students with all aspects of technology used in modern RFID systems, including the near and far field electromagnetic coupling concept for detecting objects. The physics, design, data structures and control mechanisms for RFID systems are covered. Students will also be familiarized with associated standards, emerging business process models, applications, and social issues arising from the use of the RFID.

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>has detailed knowledge on the physical phenomena that governs the operation of near and far field RFID systems at the RF and microwave spectrum levels</td>
<td>test</td>
<td>lecture</td>
<td></td>
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<tr>
<td>2.</td>
<td>has detailed knowledge on the structure of RF, UHF and microwave tags and readers</td>
<td>test</td>
<td>lecture</td>
<td></td>
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<tr>
<td>3.</td>
<td>understands the advantages and disadvantages of different modulation, coding and encryption methods in RFID systems</td>
<td>test</td>
<td>lecture</td>
<td></td>
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<tr>
<td>4.</td>
<td>has detailed knowledge on the limitations of security methods used with respect to user privacy, robustness, application requirements and cost</td>
<td>test</td>
<td>lecture</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>is familiar in general level with the most important RFID standards</td>
<td>test</td>
<td>lecture</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>can analyze theoretical and practical effects of tag interference and interreader interference in RFID systems and basic anti-collision procedures</td>
<td>test</td>
<td>lecture</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>can implement RFID technology in ICT systems to satisfy application needs in the areas of ID management, tracking, sensing, electronic payment, and industrial automation</td>
<td>test</td>
<td>lecture</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>can cooperate with other people to design, develop, prototype and evaluate an RFID system, as part of a team</td>
<td>test</td>
<td>lecture</td>
<td></td>
</tr>
</tbody>
</table>

18. **Teaching modes and hours**

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

   **Lecture:** 30 h
19. Syllabus description:

Lecture:
1. RFID background: history, architecture, applications, shareholders, social implications and privacy
2. Barcode and barcode systems: EAN-8 and EAN-13 barcode, UPC-7 and UPC-12 barcode, 2D and 3D barcodes, the pros and cons of barcode systems
3. Tag layer: tag classification, architecture, tag placement - shadowing risk and mitigation, antenna configurations
4. Reader layer: reader classification, architecture, deployment requirements, interrogation zones, antenna configurations, sessions, middleware, SmartLabel printers
5. Media interface layer: frequency bands, read range, modulation, encoding, communication protocols, data rates, reader and tag collisions, anti-collision protocols, tag-to-tag and reader-to-reader interference, tag travel speed
6. RFID security and privacy: interactions with wireless LANs, chip clones, cryptography, symmetric ciphers, asymmetric ciphers, elliptic curve ciphers, authentication protocols, weaknesses in the encryption algorithm, weaknesses in key management, EPC trust services
7. RFID standards: regulations, policies and guidelines: EPCglobal, ISO/IEC item management, contactless Smart Cards, animal identification, FCC rules for ISM band, identity standards and guidelines for securing RFID systems
8. Case studies: patient tracking, blood services banks, boost asset awareness, asset-tracking platform, RFID pharmaceuticals seek system, library management system, public transport, ticketing, access control systems, animal identifications, electronic immobilization, container identification, industrial automation, sport events

20. Examination: Lecture - test

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>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>40/20</td>
</tr>
</tbody>
</table>

24. Total hours: 60

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): 0

26. Comments:

Approved:

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