1. **Course title:** CIRCUIT THEORY

2. **Course code:** CT

3. **Validity of course description:** 2012/2013

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

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

6. **Field of study:** Control, Electronic, and Information Engineering

7. **Profile of studies:** RAU

8. **Programme:**

9. **Semester:** 1, 2

10. **Faculty teaching the course:** Institute of electronics, RAu3

11. **Course instructor:** prof. dr hab. inż. J. Rutkowski, dr hab. inż. D. Grzechca

12. **Course classification:**

13. **Course status:** compulsory

14. **Language of instruction:** English

15. **Pre-requisite qualifications:** Course attendants are supposed to have general knowledge concerning mathematics (including the ability to solve algebraic equations, operations on complex numbers, differentiation and integration of basic functions), physics (elementary concepts and laws such as the electrostatic field, familiarity with the basic electrical units).

16. **Course objectives:**

   **CT1:** The main objective of the course is to provide the students with basic and advanced knowledge concerning linear and nonlinear direct current (DC) circuits. During the course, the students should develop skills concerning the analysis methods of these circuits.

   **CT2:** The main objective of the course is to provide the students with basic and advanced knowledge concerning alternating current (AC) circuits and time domain circuits with aperiodic stimulus: RLC circuits and transmission line. The students should understand differences between these circuits and know how to analyze them in both time and frequency domain.

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>W1</td>
<td>A student is familiar with basic terms, concepts and laws of electrical circuits (CT1 &amp; CT2)</td>
<td>Exam</td>
<td>Lecture</td>
<td>K1A_W05</td>
</tr>
<tr>
<td>W2</td>
<td>A student knows fundamental methods of analysis of DC circuits (CT1)</td>
<td>Assessment test</td>
<td>Lecture</td>
<td>K1A_W05</td>
</tr>
<tr>
<td>W3</td>
<td>A student knows fundamental methods of analysis of AC circuits and methods of transient analysis in RLC circuits and transmission line (CT1 &amp; CT2)</td>
<td>Exam</td>
<td>Lecture</td>
<td>K1A_W05</td>
</tr>
<tr>
<td>W4</td>
<td>A student is able to solve problems by means of electric circuit simulator (CT1 &amp; CT2)</td>
<td>Exam</td>
<td>Lecture/Laboratory</td>
<td>K1A_W17</td>
</tr>
<tr>
<td>U1</td>
<td>A student has ability to Self-Directed Learning, readiness to adapt Flip-Teaching (CT1 &amp; CT2)</td>
<td>Exam</td>
<td>Lecture</td>
<td>K1A_U05</td>
</tr>
<tr>
<td>U2</td>
<td>A student is able to analyze DC circuits (CT1)</td>
<td>Assessment test</td>
<td>Classes</td>
<td>K1A-U13</td>
</tr>
<tr>
<td>U3</td>
<td>A student is able to analyze AC circuits, perform transient analysis of RLC circuits and transmission line (CT1 &amp; CT2)</td>
<td>Exam</td>
<td>Classes</td>
<td>K1A-U13</td>
</tr>
<tr>
<td>U4</td>
<td>A student knows how to measure basic electric quantities, transient and frequency response of RLC circuits (CT2)</td>
<td>Laboratory assessment test</td>
<td>Laboratory</td>
<td>K1A_U18, K1A_U20</td>
</tr>
</tbody>
</table>

18. **Teaching modes and hours**

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

   Sem. 1: 30 h (Lecture), 30 h (Classes); Sem. 2: 30 h (Lecture), 15 h (Classes), 15 h (Laboratory)
19. Syllabus description:

Semester 1:

Lecture:
1. Introduction to circuit theory, circuit variables - basic terms and definitions, classification of circuit theory problems, dc analysis, circuit elements, classification.
3. Analysis of complex circuits: node voltage (nodal) analysis, PSpice simulations.
5. Separation principle (source substitution theorem). Maximum power transfer theorem.

Classes:
3. Circuits with ideal and real ammeter and/or voltmeter. Power balance.
4. Nodal analysis, PSpice simulation.
5. Equivalent resistance, Thevenin's and Norton's theorems. Practical sources.
11. Assessment test
12. Element (RLC) equations in time domain.

Semester 2:

Lecture:
2. Natural response of the 2nd order circuit.
3. Laplace Transfer Function – properties and selected examples. Integrator and Differentiator, ideal and practical (RC).
6. Phasor analysis - PSpice simulations. AC steady-state power and energy: instantaneous power, average or real power, apparent power, reactive power, complex power. Maximum power transfer.
8. Transfer function approach - frequency response. Bode (logarithmic) plot.
13. Transient analysis in not-matched transmission line.

Classes:
2. Forced and natural response of the 2nd order circuit.
3. Integrator & differentiator. Transients with arbitrary aperiodic stimulus (pulse).
5. Frequency characteristic of two-port circuit. Resonant circuits
7. Time domain analysis of not-matched transmission line.

Laboratory:
1. Introduction to laboratory and to work with oscilloscope
2. Transient in first order circuits with zero initial conditions switched on a DC source
3. Transient in higher order circuits with zero initial conditions switched on a DC source
4. Transient in circuits with non-zero initial conditions
5. Resonance and frequency response
6. Transmission lines
20. **Assessments:** Semester 1: written assessment test; Semester 2: Examination - written test; Laboratory: positive grade required for each laboratory exercise.

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>60/30</td>
</tr>
<tr>
<td>2</td>
<td>Classes</td>
<td>45/55</td>
</tr>
<tr>
<td>3</td>
<td>Laboratory</td>
<td>15/60</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>20/35</td>
</tr>
<tr>
<td></td>
<td>Total number of hours</td>
<td>140/180</td>
</tr>
</tbody>
</table>

24. **Total hours:** 320

25. **Number of ECTS credits:** 11

26. **Number of ECTS credits allocated for contact hours:** 5

27. **Number of ECTS credits allocated for in-practice hours (laboratory, classes):** 2x3=6

26. **Comments:**