GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | Circuits and Signals, PG_00047549 | | |
| Field of study | Automatic Control, Cybernetics and Robotics | | |
| Date of commencement of studies | October 2020 | Academic year of realisation of subject | 2020/2021 |
| Education level | first-cycle studies | Subject group | Obligatory subject group in the field of study |
| Mode of study | Full-time studies | Mode of delivery | at the university |
| Year of study | 1 | Language of instruction | Polish |
| Semester of study | 2 | ECTS credits | 4.0 |
| Learning profile | general academic profile | Assessment form | exam |
| Conducting unit | Department of Marine Electronic Systems -> Faculty of Electronics, Telecommunications and Informatics | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr inż. Czesław Stefański | |
| | Teachers | dr inż. Czesław Stefański<br>dr inż. Marek Makowski | |

**Lesson types and methods of instruction**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 30.0 | 15.0 | 0.0 | 0.0 | 0.0 | 45 |
| E-learning hours included: 0.0 | | | | | | |

**Learning activity and number of study hours**

| Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
|---|---|---|---|---|
| Number of study hours | 45 | 4.0 | 51.0 | 100 |

**Subject objectives**

Equipping a student with knowledge and skills acquired in studying the basics of analogue circuits and signals. The knowledge is sought to be useful in further professional studies and practice.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K6_W03] Knows and understands, to an advanced extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum | Student knows the methods of analysis of linear analog circuits and elementary nonlinear systems, knows the analytical approach in the time domain, s-domain , the phasor approach and spectral analysis using the Fourier series, as well as a simulation approach in the analysis of circuits. | [SW1] Assessment of factual knowledge |
| [K6_U03] can design, according to required specifications, and make a simple device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment | Ability to analyze and design typical simple devices / systems using the experience and standards gained in the direction of AiR course. | [SU1] Assessment of task fulfilment |

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| Subject contents | 1. Basic electric circuit variables and their units.<br>2. Models of basic electric circuit elements.<br>3. Static and dynamic parameters of basic electric circuit elements.<br>4. Linearity and time invariance of electric circuits.<br>5. Quasistationarity versus a long delay-line.<br>6. Operational amplifier and its typical applications.<br>7. Analysis of circuits containing operational amplifiers.<br>8. Independent voltage and current sources, ideal and real. Controlled sources.<br>9. Kirchhoff"s current and voltage laws.<br>10. One-port, two-port and multi-port - examples.<br>11. Analysis of linear circuits: connection of elements, equivalent resistance, transformation "triangle-to star", current and voltage divisors.<br>12. The principle of superposition.<br>13. Thevenin and Norton equivalent circuits.<br>14. The loop-current and the node-voltage methods.<br>15. Standard continuous-time signals. Causality.<br>16. The Laplace transformation.<br>17. Transfer function. Examples.<br>18. Transients in basic linear circuits.<br>19. Steady -state response of basic linear circuits.<br>20. Phasor circuits.<br>21. Maximum power transfer - load match.<br>22. Time-domain circuit characteristics.<br>23. Frequency responses of linear circuits.<br>24. Stability.<br>25. Resonant circuits.<br>26. Examples of analysis of resonant circuits.<br>27. Nonlinear circuits - responses for constant and sinusoidal excitations.<br>28. The Fourier series.<br>29. The spectrum of a periodic function. Circuit response for a periodic function.<br>30. Circuit analysis computer programs. |
| Prerequisites and co-requisites | |
| Assessment methods and criteria | see table below |

| Subject passing criteria | Passing threshold | Percentage of the final grade |
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| Written exam | 51.0% | 70.0% |
| Midterm colloquium | 51.0% | 30.0% |

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| Recommended reading | Basic literature | J. Osiowski and J. Szabatin: Fundamentals of circuit theory, volumes I, II and III. WNT Warszawa 1993 (volume I and volume II) and 1995 (volume III) and subsequent editions.<br>A. Leśnicki: Analog signal technique, volumes 1 and 2, Gdansk University of Technology Publishing House, Gdańsk 2014.<br>C. Stefanski: Circuit and signal primer (available at https://enauczanie.pg.edu.pl/moodle/course/view.php?id=638)<br>(all in Polish) |
| | Supplementary literature | No requirements |
| | eResources addresses | |

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| Example issues/ example questions/ tasks being completed | 1. Refer what we mean by 'equivalent circuits'. In a linear network given, determine in steps the equivalent Thevenin parameters and discuss the possible methods of solution.<br>2. Give a definition of a causal signal. Calculate, in a given first-order circuit the step and/or the impulse response.<br>3. List the known properties of the Laplace transformation. Based solely on that knowledge (without direct referring to Laplace formula, if possible) perform how to calculate the transform of an exemplary piece-wise linear/constant causal signal.<br>4. Discuss the application of the method of phasors and give an example of an RLC circuit in which you have to determine analitically the output waveform. How does the solution modify in case we change the excitation from cosinus to sinus or vice versa?<br>5. Consider we have a periodic signal. Give a definition of it's spectra in Fourier terms. Calculate and/or sketch the spectra of a square wave. |
| Work placement | Not applicable |