



Subject card

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|---|--|--|-------------------------------------|------------|--|---------|-----|
| Subject name and code | Circuits and Signals, PG_00067029 | | | | | | |
| Field of study | Electronics and Telecommunications | | | | | | |
| Date of commencement of studies | October 2025 | Academic year of realisation of subject | | | 2025/2026 | | |
| Education level | first-cycle studies | Subject group | | | Obligatory subject group in the field of study Subject group related to scientific research 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 | | | 5.0 | | |
| Learning profile | general academic profile | Assessment form | | | exam | | |
| Conducting unit | Department of Signals and Systems -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology | | | | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr inż. Kamil Stawiarski | | | | | |
| | Teachers | mgr inż. Hubert Boratyński mgr inż. Damian Kąkol dr inż. Kamil Stawiarski dr hab. inż. Iwona Kochańska mgr inż. Mariusz Rudnicki | | | | | |
| Lesson types | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
| | Number of study hours | 30.0 | 30.0 | 0.0 | 0.0 | 0.0 | 60 |
| | E-learning hours included: 0.0 | | | | | | |
| | eNauczanie source addresses: Moodle ID: 4691 Obwody i sygnały 2026 https://enauczanie.pg.edu.pl/2025/course/view.php?id=4691 | | | | | | |
| 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 | 60 | 5.0 | | 60.0 | 125 | |
| Subject objectives | <p>The aim of the Circuits and Signals course is to introduce students to the fundamentals of electrical circuit analysis, modeling, and signal analysis techniques. The course covers the properties of linear and energy-storing elements, analysis of DC and AC circuits, power balance, the use of operational amplifiers and controlled sources.</p> <p>Students will acquire skills in applying classical and operator methods (Laplace transform, Fourier transform) to analyze dynamic circuits, determine transfer functions, and derive frequency response characteristics. The course also introduces the principles of signal filtering (passive and active filters), resonance circuits, and phasor methods for steady-state analysis of sinusoidal signals.</p> | | | | | | |

| Learning outcomes | Course outcome | Subject outcome | Method of verification |
|-------------------|--|--|--|
| | [K6_W01] knows and understands, to an advanced extent, mathematics necessary to formulate and solve simple issues related to the field of study | The student knows and understands the basic mathematical concepts and methods necessary for analyzing and describing electrical circuits and signals, including operations on complex numbers, algebraic equations, and simple functional relationships used to solve problems related to the field of study. | [SW2] Assessment of knowledge contained in presentation |
| | [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 | The student knows and understands the structure and principles of operation of electrical components and systems, as well as methods for circuit analysis in the time and frequency domains. Possesses knowledge of the complex relationships between circuit elements and the influence of signal parameters on system behavior. Understands theories and methods of signal analysis and filtering in engineering applications. | [SW2] Assessment of knowledge contained in presentation |
| | [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 | The student has knowledge and skills in analyzing, modeling, and designing basic electrical circuits and signal systems. Is able to select and apply appropriate engineering methods and tools to implement simple circuit and filtering tasks in accordance with relevant standards. Can interpret and verify analysis results based on practical and simulation experience. | [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject |
| | [K6_U01] can apply mathematical knowledge to formulate and solve complex and non-typical problems related to the field of study and perform tasks, in an innovative way, in not entirely predictable conditions, by:n- appropriate selection of sources and information obtained from them, assessment, critical analysis and synthesis of this information,n- selection and application of appropriate methods and toolsn | The student is able to analyze complex electrical circuits and signal systems using mathematical knowledge, in particular by selecting appropriate analysis methods, computational tools, and information from various sources to solve problems related to circuits in the time and frequency domains, signal filtering, and systems with linear and controlled elements. | [SU2] Assessment of ability to analyse information |

| Subject contents | <p>Course content – lecture</p> <ol style="list-style-type: none"> 1. Introduction to electrical circuit theory. 2. Linear and nonlinear components characteristics and models. 3. Analysis of DC circuits using mesh and node methods. 4. Controlled sources and their application in circuit analysis. 5. Operational amplifiers models and basic configurations. 6. Power balance in DC circuits. 7. Energy-storing elements capacitors and inductors, dynamic characteristics. 8. Differential equations describing dynamic circuits. 9. Introduction to the Laplace transform and its properties. 10. Solving circuit equations using the Laplace transform. 11. Operator impedances of R, L, C components. 12. Transfer function definition and applications. 13. Methods for determining transfer functions in linear circuits. 14. Analysis of dynamic circuits with initial conditions. 15. Sinusoidal steady-state analysis concept of complex impedance. 16. Phasor method in AC steady-state analysis. 17. Active, reactive, and apparent power in AC circuits. 18. Maximum power transfer impedance matching principle. 19. Series and parallel resonant circuits resonance conditions. 20. Frequency characteristics of circuits Bode plots. 21. Introduction to passive RLC filters. 22. Low-pass, high-pass, band-pass, and band-stop filters. 23. Filter parameters: passband, attenuation, slope steepness. 24. Analog active filters basic operation and configurations. 25. Fourier transform analysis of periodic and non-periodic signals. 26. Signal spectrum definition and determination. 27. Effect of filtering on the spectrum of composite signals. 28. Application of computer simulations in circuit analysis. 29. Comparison of classical and operator methods in circuit analysis. 30. Practical design and analysis of simple filtering circuits. <p>Course content – exercises</p> <ol style="list-style-type: none"> 1. Calculating currents and voltages in simple DC circuits. 2. Applying mesh and node analysis methods to circuit analysis. 3. Determining power balance in electrical circuits. 4. Analyzing circuits with controlled sources and operational amplifiers. 5. Determining parameters of dynamic circuits with RR, LL, and CC elements. 6. Solving circuit equations using the Laplace transform. 7. Analyzing steady-state conditions in sinusoidal current circuits. 8. Determining impedance, power, and resonance conditions. 9. Determining frequency characteristics and transfer functions of circuits. 10. Analyzing and designing simple filtering circuits. 11. Determining signal spectra and the effect of filtering on composite signals. 12. Using computer simulation for circuit analysis. | | | | | | | | | | | |
|--|--|-------------------------------|--|--------------------------|---|-------------------------------|--------------------------|-----------------|-------|----------------------|-------|-------|
| Prerequisites and co-requisites | | | | | | | | | | | | |
| Assessment methods and criteria | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">Subject passing criteria</th> <th style="width: 33%;">Passing threshold</th> <th style="width: 33%;">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Midterm colloquium</td> <td>51.0%</td> <td>60.0%</td> </tr> <tr> <td>Written exam</td> <td>51.0%</td> <td>40.0%</td> </tr> </tbody> </table> | | | Subject passing criteria | Passing threshold | Percentage of the final grade | Midterm colloquium | 51.0% | 60.0% | Written exam | 51.0% | 40.0% |
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| Midterm colloquium | 51.0% | 60.0% | | | | | | | | | | |
| Written exam | 51.0% | 40.0% | | | | | | | | | | |
| Recommended reading | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Basic literature</td> <td colspan="2"> <p>J. David Irwin, R. Mark Nelms, Basic Engineering Circuit Analysis</p> <p>J. Osiowski i J. Szabatın: Podstawy teorii obwodów, tom I, II i III. WNT Warszawa 1993 (tom I i tom II) i 1995 (tom III) i późniejsze wydania.</p> <p>A. Leśnicki: Technika sygnałów analogowych, tom 1 i 2, Wydawnictwo Politechniki Gdańskiej, Gdańsk 2014.</p> </td> </tr> <tr> <td>Supplementary literature</td> <td colspan="2">No requirements</td> </tr> <tr> <td>eResources addresses</td> <td colspan="2"></td> </tr> </table> | | | Basic literature | <p>J. David Irwin, R. Mark Nelms, Basic Engineering Circuit Analysis</p> <p>J. Osiowski i J. Szabatın: Podstawy teorii obwodów, tom I, II i III. WNT Warszawa 1993 (tom I i tom II) i 1995 (tom III) i późniejsze wydania.</p> <p>A. Leśnicki: Technika sygnałów analogowych, tom 1 i 2, Wydawnictwo Politechniki Gdańskiej, Gdańsk 2014.</p> | | Supplementary literature | No requirements | | eResources addresses | | |
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| Supplementary literature | No requirements | | | | | | | | | | | |
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| Example issues/ example questions/ tasks being completed | <ol style="list-style-type: none"> 1. Explain the concept of a Thevenin equivalent circuit. For a given linear electrical network, determine the parameters of its Thevenin equivalent source, clearly naming each step of the procedure. Discuss possible methods for determining these parameters. 2. Provide the definition of a causal signal. For a given first-order circuit, determine its unit step and/or impulse response. 3. List the most important properties of the Laplace transform. Based on these properties alone without referring to the definition formulas demonstrate how to determine Laplace transforms for piecewise constant and piecewise linear waveforms. 4. Discuss the application of the phasor (frequency domain) analysis method in the analysis of AC circuits. For a selected RLC circuit, analytically determine the output signal. Explain how your procedure would change if the excitation were switched from a cosine function to a sine function, and vice versa. 5. State the definition of the spectrum of a periodic signal based on the components present in its Fourier series representation. Calculate and/or sketch the spectrum of a rectangular (square) wave. | | | | | | | | | | | |
| Practical activities within the subject | Not applicable | | | | | | | | | | | |

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