



Subject card

Subject name and code	Circuits and Signals, PG_00068170						
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering						
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		
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 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		dr Tomasz Neumann				
			dr inż. Adam Bujnowski				
			dr inż. Kamil Stawiarski				
Lesson types	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						
	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	45		5.0		50.0	100
Subject objectives	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. 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.						

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	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
Subject contents	Course content – lecture 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.		
	Course content – exercises 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	Subject passing criteria	Passing threshold	Percentage of the final grade
	Midterm colloquium	51.0%	60.0%
	Written exam	51.0%	40.0%

Recommended reading	Basic literature	J. David Irwin, R. Mark Nelms, Basic Engineering Circuit Analysis J. Osiowski i J. Szabatin: Podstawy teorii obwodów, tom I, II i III. WNT Warszawa 1993 (tom I i tom II) i 1995 (tom III) i późniejsze wydania. A. Leśnicki: Technika sygnałów analogowych, tom 1 i 2, Wydawnictwo Politechniki Gdańskiej, Gdańsk 2014.
	Supplementary literature	No requirements
	eResources addresses	
Example issues/ example questions/ tasks being completed	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	

Document generated electronically. Does not require a seal or signature.