GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Electronic circuits, PG_00057025					
Field of study	Mechatronics					
Date of commencement of studies	February 2024		Academic year of realisation of subject		2023/2024	
Education level	second-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	1		ECTS credits		3.0	
Learning profile	general academic profile		Assessment form		assessment	
Conducting unit	Department of Microelectronic Systems -> Faculty of Electronics, Telecommunications and Informatics					
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Wiesław Kordalski				
	Teachers	dr hab. inż. Wiesław Kordalski				
		dr hab. inż. Piotr Płotka				

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	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	2.0	28.0	75

Subject objectives	Acquiring abilities to select most suitable methods of implementation of electronic systems for mechatronic applications with standardized circuits, with programmable circuits or with application specific integrated circuits.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_U09] is able to evaluate feasibility of advanced methods and tools (including programmistic and for computer aided design and manuacturing) for solving complex, practical engineering task, characteristic for mechatronics, and to choose and apply proper method and tools	Student is able to assess the suitability and ability to use new developments (techniques and technologies) in the field of mechatronics. Student presents applications of integrated electronic circuits in mechatronic systems. Is able to find out the suitability of a given fabrication method for the mechatronic systems that he designs.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject
	[K7_W10] knows development trends and most important new achievements in technical sciences and science disciplines: Mechanical Engineering, Automation, Electronics and Electrical Engineering and related: Informatics and Materials Engineering	Student knows the current solutions of electronic circuits, which find applications in mechatronic systems. Student is able to notice advantages and chances related to integration of circuit and system functionalities.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
	[K7_U04] is able to utilise known methods and mathematical models, as well as computer simulations for analysis and evaluation of non-stationary continuous and discrete mechatronic systems and processes	Student is able to apply the appropriate mathematical, physical and computer methods in analysis and design of electronic circuits. In particular, he is able to simulate operation of basic electronic circuits such as rectifiers, amplifiers, generators, multivibrators, and CMOS inverters. He is able to apply this knowledge for circuit solutions of modern integrated circuits.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
	[K7_W04] has detailed, supported by the theory knowledge in terms of electronic circuits, microelectronics and optoelectronics	Student is theoretically founded a detailed knowledge of electronic circuits. Student explains principles of operation of basic electronic circuits such as rectifiers, elctronic amplifiers, generators, multivibrators, and CMOS inverters. Knows basic circuit solutions for modern integrated circuits.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects

Subject contents	
	1. Introduction to analog and digital electronic circuits. 2. Some aspects of circuit theory. 3. Analog and digitalsignals. 4. Digitalization of electronic signals; Nyquist's theorem. 5. Small-signal models of transistors and electronic amplifiers. 6. Operational amplifiers and their applications. 7. Power amplifiers. 8. Rectifiers and dc-to-dc converters. 9. Spectrum of periodic and nonperiodic electronic signals; linear and nonlinear signal distortionsin electronic circuits. 10. Analog filters. 11. Microelectromechanical systems (MEMS). 12. Sine wave generators;relaxation oscillators and multivibrators. 13 CMOS inverter.

Basic families of integrated circuits - classifications based on application types, devices used for constructions. Application specific integrated circuits. Effect of scaling on parametrs of integrated circuits. Introduction to fabrication methods of modern integrated circuits. Device integration in contemporary, advanced MOS technologies. Logic gates in silicon technologies: CMOS, BiCMOS, ECL construction and issues in designing. Sequential logic circuits in silicon technologies. Memory circuits of RAM, ROM and FLASH types in silicon technologies. Prospectives and problems of integration of mesoscopic devices operating with two- one- or zero-dimensional physics. Prospectives of application of new materials other than silicon.

LABORATORY list of topics:1. Introductory remarks. 2. Measurements of a input stage of an operational amplifier. 3. Selected applications of the operational amplifier. 4. Negative feedback in amplifiers. 5. Bipolar transistor basic configurations of operation. 6. MOS transistor basic configurations of operation. 7. Audio amplifier. 8. Amplifier with resonance circuit. |

Prerequisites and co-requisites	no prerequisites		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	laboratory	50.0%	50.0%
	written test	50.0%	50.0%

Recommended reading	Basic literature	1. J. Watson: Elektronika, WKiŁ, 2002. 2. P. Horowitz i W. Hill: Sztuka elektroniki, WKiŁ, 1996. 3. M. Polowczyk , A. Jurewicz: Elektronika dla Mechaników, Wyd. PG,2002. R. Jacob Baker, "CMOS: Circuit Design, Layout, and Simulation", Wiley, 2008, - diagrams, examples, Spice and Cadence models: http://cmosedu.com/cmos1/book.htm
	Supplementary literature	1. A. Sedra and K. C Smith: Microelectronic circuits, Oxford, 2007. 2. J. Osiowski, J. Szabatin: Podstawy teorii obwodów, t.2, WNT. 3. M. Polowczyk , E. Klugmann: Przyrządy półprzewodnikowe, Wyd. PG,1996. B. Razavi, "Fundamentals of Microelectronics", Wiley, 2006 H. Veendrick, "Nanometer CMOS ICs: from Basics to ASICs", Springer, 2008
	eResources addresses	Adresy na platformie eNauczanie: Układy Elektroniczne, W, L, MTR, II st._2024 - Moodle ID: 35320 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=35320

Example issues/ example questions/ tasks being completed	Draw the schematic of a typical MOS transistor amplifier in common-source configuration, find its finalequivalent small-signal circuit for ac analysis, and calculate the voltage gain of the amplifier for midband frequency. Draw a circuit diagram and a mask layout for a CMOS gate implementing a function of: not F = (A and B) or C
Work placement	Not applicable