GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Electronic systems, PG_00064787		
Field of study	Mechatronics		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2026/2027
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	Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Piotr Płotka	
	Teachers	dr hab. inż. Wiesław Kordalski dr hab. inż. Piotr Płotka	

Lesson types	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	8.0	22.0	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_U01] utilizes acquired analytical, simulation, and experimental methods, as well as mathematical models for analysis and evaluation of stationary and non-stationary mechatronic systems/processes with continuous and discrete operation	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.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment
[K7_U15] evaluates the feasibility of advanced methods and tools for solving complex engineering tasks of a practical nature, characteristic of the field of study, and selects and applies appropriate methods and tools for this purpose	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.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment
[K7_W01] explains and describes, based on general knowledge in the field of scientific disciplines forming the theoretical foundations of Mechatronics, the construction and principles of operation of mechatronic systems, processes and their components, as well as methods and means of their integration	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
[K7_W02] demonstrates structured and theory supported knowledge encompassing key issues in the field of Mechatronics, enabling modeling and analysis of stationary and non-stationary mechatronic systems, devices, and processes with continuous and discrete operation	Student has a theoretically founded detailed knowledge on analysis of operation, as well as on models useful in designing of electronic circuits.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge

Subject contents

Course content – lecture

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

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory reports	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. 4.a. R. Jacob Baker, "CMOS: Circuit Design, Layout, and Simulation", Wiley, 2008, 4.b. 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. 3.a. R. Jacob Baker, "CMOS: Circuit Design, Layout, and Simulation", Wiley, 2008, 3.b. diagrams, examples, Spice and Cadence models: http://cmosedu.com/cmos1/book.htm 4. B. Razavi, "Fundamentals of Microelectronics", Wiley, 2006 4. H. Veendrick, "Nanometer CMOS ICs: from Basics to ASICs", Springer, 2008
	eResources addresses	
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	
Practical activites within the subject	Not applicable	

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