GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Electronic circuits, PG_00057025		
Field of study	Mechatronics		
Date of commencement of studies	February 2022	Academic year of realisation of subject	2021/2022
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. Piotr Płotka	
	Teachers	dr hab. inż. Wiesław Kordalski	

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.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="3">no prerequisites</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>laboratory</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>written test</td><td>50.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">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</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">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 półprzwodnikowe, Wyd. PG,1996.

B. Razavi, "Fundamentals of Microelectronics", Wiley, 2006

H. Veendrick, "Nanometer CMOS ICs: from Basics to ASICs", Springer, 2008</td></tr>
<tr><td>eResources addresses</td><td colspan="2"></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">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</td></tr>
<tr><td>Work placement</td><td colspan="3">Not applicable</td></tr>
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