GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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|---|---|---|---|---|---|---|---|
| Subject name and code | Electronic systems, PG_00064787 | | | | | | |
| Field of study | Mechatronics | | | | | | |
| Date of commencement of studies | February 2025 | | Academic year of realisation of subject | 2024/2025 | | | |
| Education level | second-cycle studies | | Subject group | Obligatory subject group in the field of study<br>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 | | | | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | | dr hab. inż. Piotr Płotka | | | | |
| | Teachers | | | | | | |
| 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 | | 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<br>[SU3] Assessment of ability to use knowledge gained from the subject<br>[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<br>[SU3] Assessment of ability to use knowledge gained from the subject<br>[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<br>[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<br>[SW1] Assessment of factual knowledge |

## 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

## 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% |

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| Recommended reading | Basic literature | 1. J. Watson: Elektronika, WKiŁ, 2002.<br>2. P. Horowitz i W. Hill: Sztuka elektroniki, WKiŁ, 1996.<br>3. M. Polowczyk , A. Jurewicz: Elektronika dla Mechaników, Wyd. PG, 2002.<br>4.a. R. Jacob Baker, "CMOS: Circuit Design, Layout, and Simulation", Wiley, 2008,<br>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.<br>3.a. R. Jacob Baker, "CMOS: Circuit Design, Layout, and Simulation", Wiley, 2008,<br>3.b. diagrams, examples, Spice and Cadence models: http://cmosedu.com/cmos1/book.htm<br>4. B. Razavi, "Fundamentals of Microelectronics", Wiley, 2006<br>4. H. Veendrick, "Nanometer CMOS ICs: from Basics to ASICs", Springer, 2008 |
| | eResources addresses | Adresy na platformie eNauczanie: |
| 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.<br><br>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 | |

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