GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Analog Electronic Circuits, PG_00067033		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2027/2028
Education level	first-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	2	Language of instruction	Polish
Semester of study	4	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Microelectronic Systems -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Bogdan Pankiewicz	
	Teachers	dr hab. inż. Bogdan Pankiewicz	

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

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	3.0	27.0	75

Subject objectives

The aim of the course is to familiarize participants with the structure, operating principles, and analysis of basic analog electronic circuits, both linear and nonlinear. The course covers topics related to the use of bipolar and MOS transistors in the construction of fundamental electronic systems. Students will also learn about the structure and characteristics of real operational amplifiers and how to use them in the design of a wide range of electronic circuits, such as amplifiers, nonlinear converters, and harmonic oscillators.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U12] can analyze the operation of components, circuits and systems related to the field of study, as well as measure their parameters and examine technical specifications, and plan and conduct experiments related to the field of study, including computer simulations and measurements, and interpret obtained results and draw conclusions	The student defines and explains performance parameters of analog l electronic circuits. The student indicates and explains applications of analog electronic circuits.	[SU4] Assessment of ability to use methods and tools
[K6_W10] knows and understands, to an advanced extent, the parameters, functions, and methods of analysis, design, and optimization of electronic circuits and systems, the definitions of error and measurement uncertainty, measurement methods, including time, frequency, and phase measurements, the properties of converters, and methods of digital signal processing, as well as the basic processes occurring in the life cycle of technical devices, objects, and systems, and methods of supporting processes and functions, specific to the field of study	The student knows the structure and parameters of basic analog linear and nonlinear electronic circuits, as well as their applications.	[SW1] Assessment of factual knowledge
[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 defines and explains performance parameters of analog l electronic circuits. The student indicates and explains applications of analog electronic circuits.	[SU4] Assessment of ability to use methods and tools
[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 the structure and parameters of basic analog linear and nonlinear electronic circuits, as well as their applications.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture
The lecture will cover the following topics:
1) DC characteristics of bipolar and field-effect transistors, as well as their small-signal equivalent models.
2) Power supply of bipolar transistor amplifiers.
3) Analysis and characteristics of bipolar amplifiers in basic operating configurations.
4) Power supply of MOS transistor amplifiers.
5) Analysis and characteristics of MOS amplifiers in basic operating configurations.
6) Frequency characteristics of wideband transistor amplifiers.
7) Structure and parameters of operational amplifiers.
8) Application of operational amplifiers in the design of basic electronic circuits.
9) Use of negative feedback.
10) Introduction to switched-capacitor circuits.
11) Diode amplitude detector.
12) Half-wave and full-wave rectifiers.
13) Parallel voltage regulator with a Zener diode.
14) Series voltage regulators.
15) Analysis of the nonlinear properties of bipolar and MOS amplifiers, as well as differential pairs.
16) Gilbert multiplier.
17) RC harmonic oscillators.
18) Resonant amplifiers and harmonic oscillators with a resonant circuit.
19) Schmitt trigger.
20) Relaxation oscillators.
21) Phase detector.

As part of the course exercises, students will solve problems aligned with the lecture content. It is expected that 2 to 3 calculation-based problems will be solved during each class hour.

<table>
<tr><td>Prerequisites and co-requisites</td><td></td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Homework and attendance</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>Written exam</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>1) Guziński A: "Liniowe elektroniczne układy analogowe", WNT, 1994.
2) Sedra A.S., Smith K.C.: "Microelectronic circuits", Oxford University Press, New York, Oxford, 2020.
3) Niedźwiecki M, Rasiukiewicz M.: "Nieliniowe elektroniczne układy analogowe", WNT 1991.
4) Tietze U., Schenk Ch.:"Electronic Circuits --- Handbook for Design and Applications",Springer 2nd edition, 2008.</td></tr>
<tr><td>Supplementary literature</td><td>No requirements</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">1) Calculate the operating point of an amplifier with a bipolar or MOS transistor.
2) Calculate the values of the small-signal equivalent model parameters of a transistor.
3) Draw the small-signal equivalent circuit of a transistor amplifier for mid-frequency range.
4) Calculate the small-signal voltage gain, input resistance, and output resistance of a transistor amplifier.
5) Draw the small-signal equivalent circuit of the amplifier for low frequencies.
6) Draw the small-signal equivalent circuit of the amplifier for high frequencies.
7) Calculate the cutoff frequencies of a transistor amplifier.
8) Apply Miller's theorem to determine the upper cutoff frequency of a transistor amplifier.
9) Provide the parameters of ideal and real operational amplifiers.
10) Provide circuits and parameters of circuits using operational amplifiers.
11) State the properties of negative feedback.
12) State the characteristics of switched-capacitor circuits.
13) Calculate the parameters of a power supply with a parallel/series voltage regulator.
14) Describe the properties of transistor amplifiers operating with signals that cause low harmonic distortion.
15) State the properties of a bipolar differential pair.
16) Describe the Gilbert multiplier circuit.
17) Provide circuits of basic systems with operational amplifiers that implement simple nonlinear functions.
18) State the generation condition and properties of RC and LC harmonic oscillators.
19) Describe the principles of harmonic oscillator analysis.
20) Provide the circuit diagram and properties of a Schmitt trigger.</td></tr>
<tr><td>Practical activites within the subject</td><td colspan="2">Not applicable</td></tr>
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