GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Basic Electronic Circuits, PG_00068279		
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2027/2028
Education level	first-cycle studies	Subject group	Optional subject group
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	assessment
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	15.0	15.0	0.0	0.0	0.0	30

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	30	2.0	43.0	75

Subject objectives

Celem przedmiotu jest zapoznanie uczestników z budową, zasadami działania oraz analizy podstawowych analogowych układów elektronicznych, zarówno liniowych jak i nieliniowych. Omówione są zagadnienia wykorzystania tranzystorów bipolarnych i MOS w budowie podstawowych układów elektronicznych. W ramach kursu studenci
również poznają budowę i właściwości rzeczywistych wzmacniaczy operacyjnych oraz nauczą się wykorzystywać je
w konstrukcji szerokiej gamy układów elektronicznych takich jak wzmacniacze instrumentacyjne, filtry aktywne czy generatory drgań harmonicznych.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W04] knows and understands, to an advanced extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, and organisation of systems using computers or such devices	The student knows the structure and parameters of basic linear and nonlinear analog electronic circuits, as well as their applications.	[SW1] Assessment of factual knowledge
[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 is able to calculate the parameters of basic analog electronic circuits.	[SU1] Assessment of task fulfilment

<table>
<tr><td>Subject contents</td><td>Course content – lecture
The lecture will cover the following topics: 1. DC characteristics of bipolar and field-effect transistors and their small-signal equivalent models. 2. Biasing circuits for transistor amplifiers. 3. Analysis and characteristics of bipolar and MOS transistor amplifiers in basic configurations. 4. Frequency characteristics of broadband transistor amplifiers. 5. Structure and parameters of operational amplifiers. 6. Application of operational amplifiers in building basic electronic circuits. 7. Use of negative feedback. 8. Analysis of the nonlinear properties of bipolar amplifiers, MOS amplifiers, and differential pairs.
9. Multiplier circuits. 10. Implementation of selected nonlinear functions. 11. RC harmonic oscillators. 12. Schmitt trigger.
13. Relaxation oscillators.

As part of the course exercises, students will solve problems corresponding to the lecture content. During each exercise session, students are expected to solve two or three calculation-based problems.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Basic knowledge of circuit theory and the properties of electronic components.</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>Midterm tests during class sessions.</td><td>50.0%</td><td>50.0%</td></tr>
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</td></tr>
<tr><td>Recommended reading</td><td>
<table>
<tr><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.</td></tr>
<tr><td>Supplementary literature</td><td>1) Soclof S.: "Design and Application of Analog Integrated Circuits", Prentice Hall, 1996.
2) Tietze U., Schenk Ch.:"Electronic Circuits --- Handbook for Design and Applications", Springer 2nd edition, 2008.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Calculate the operating point of an amplifier with a bipolar or MOS transistor.
2. Calculate the values of the parameters of the transistor's small-signal equivalent model.
3. Draw the small-signal equivalent circuit diagram of a transistor amplifier for mid-frequency range.
4. Calculate the small-signal voltage gain as well as the input and output resistance of the transistor amplifier.
5. Draw the small-signal equivalent circuit diagram of the amplifier for low frequencies.
6. Draw the small-signal equivalent circuit diagram of the amplifier for high frequencies.
7. Calculate the cutoff frequencies of the transistor amplifier.
8. Apply Millers theorem to determine the upper cutoff frequency of the transistor amplifier.
9. List the parameters of ideal and real operational amplifiers.
10. Provide circuit diagrams and parameters of systems using operational amplifiers.
11. List the properties of negative feedback.
12. Describe the properties of transistor amplifiers operating with signals that cause small harmonic distortion.
13. List the properties of a bipolar differential pair.
14. Describe the Gilbert multiplier circuit.
15. Provide circuit diagrams of basic systems with operational amplifiers implementing simple nonlinear functions.
16. Explain the principles of analyzing harmonic oscillators.
17. Provide the circuit diagram and properties of a Schmitt trigger.</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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