



## Subject card

|   |   |  |          |                                     |  |            |     |
|---|---|--|----------|-------------------------------------|--|------------|-----|
| Subject name and code                       | Analog Electronic Circuits, PG_00047538   |  |          |                                     |  |            |     |
| Field of study                              | Electronics and Telecommunications  |  |          |                                     |  |            |     |
| Date of commencement of studies             | October 2022  | Academic year of realisation of subject                                    |          |                                     | 2023/2024  |            |     |
| Education level                             | first-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                               | 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                                     |  |          |                                     |  |            |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor  | prof. dr hab. inż. Stanisław Szczepański                                   |          |                                     |  |            |     |
|   | Teachers  | prof. dr hab. inż. Stanisław Szczepański<br>dr hab. inż. Bogdan Pankiewicz |          |                                     |  |            |     |
| Lesson types and methods of instruction     | Lesson type   | Lecture  | Tutorial | Laboratory                          | Project  | Seminar    | SUM |
|   | Number of study hours   | 30.0   | 0.0      | 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   |          | 3.0                                 |  | 42.0       | 75  |
| Subject objectives                          | Knowledge of methods of analysis and design of analog electronic circuits structures based on the MOSFET, JFET and bipolar transistors. |  |          |                                     |  |            |     |

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| Learning outcomes  | Course outcome  | Subject outcome  | Method of verification   |
|  | [K6_W05] Knows and understands, to an advanced extent, methods of supporting processes and functions, specific to the field of study  | The student describes and classifies the methods of supporting the design and optimization of basic analog structures and digital electronic circuits.   | [SW1] Assessment of factual knowledge                                |
|  | [K6_W06] Knows and understands the basic processes occurring in the life cycle of devices, facilities and systems specific to a given field of study.   | The student describes the basic processes in the life cycle of devices using analog and digital electronic circuits.   | [SW1] Assessment of factual knowledge                                |
|  | [K6_U06] can analyse the operation of components, circuits and systems related to the field of study, measure their parameters and examine technical specifications   | The student classifies and describes basic structures of analog and digital electronic circuits.<br>The student defines and explains the technical parameters of analog and digital electronic circuits.<br>The student indicates and explains the applications of analog and digital electronic circuits. | [SU4] Assessment of ability to use methods and tools                 |
|  | [K6_W32] Knows the parameters, functions and methods of analysis, design and optimization of analogue and digital circuits and electronic systems   | Student defines and explains technical parameters and functions of analog and digital electronic circuits.   | [SW3] Assessment of knowledge contained in written work and projects |
| [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 and digital electronic circuits. The student indicates and explains applications of analog and digital electronic circuits.   | [SU4] Assessment of ability to use methods and tools   |  |
| Subject contents   | 1. Introduction, categories of the electronic circuits 2. Power supply and biasing techniques for bipolar and MOS transistors 3. Models, DC and AC analysis of bipolar and MOS amplifiers 4. Frequency-domain analysis of bipolar and MOS amplifiers 5. Bipolar and CMOS differential amplifiers - properties and integrated circuit (IC) realizations 6. Functional blocks for linear ICs realized in bipolar and CMOS technologies 7. Operational amplifiers and their applications 8. Analytical models and analysis of IC amplifiers (bipolar and CMOS) 9. IC wideband amplifiers (bipolar and CMOS) 10. CMOS operational transconductance and transresistance amplifiers. 11. IC bandpass amplifiers 12. IC power amplifiers 13. Amplifiers with negative feedback loop. 14. Design of bipolar and CMOS amplifiers with negative feedback 15. Noise properties of active circuits 16. Synthesis methods for continuous-time active filters 17. Switched capacitor and switched current filters 18. CMOS programmable analog arrays - properties and applications 19. Analog Application Specific Integrated Circuit (ASIC) design 20. IC layout and design verification tools 21. Analog multiplier and its applications 22. Amplitude, frequency and phase detectors 23. Oscillations in the lossy resonance circuit. Negative resistance. Feedback-type oscillator structure. 24. Well-known feedback-oscillator structures 25. Relaxation-mode oscillators 26. Oscillators based on a high-Q resonator. Crystal-oscillator. 27. Signal generation in the phase-locked loop 28. Power supply rectifiers and filters. 29. Analog voltage regulators 30. Switching DC/DC and AC/DC converters. |  |  |
| Prerequisites and co-requisites  |   |  |  |
| Assessment methods and criteria  | Subject passing criteria  | Passing threshold  | Percentage of the final grade  |
|  | Written exam  | 50.0%  | 100.0%   |
| Recommended reading  | Basic literature  | Guziński A: "Liniowe elektroniczne układy analogowe", WNT, 1994<br>Tietze U., Schenk Ch.: "Układy półprzewodnikowe", WNT2009<br>Sedra A.S., Smith K.C.: "Microelectronic circuits", Oxford University Press, New York, Oxford, 2004  |  |
|  | Supplementary literature  | No requirements  |  |
|  | eResources addresses  | Adresy na platformie eNauczenie:<br>Liniowe i nieliniowe układy elektroniczne (podstawy) - 2023/24(lato) - Moodle ID: 36308<br><a href="https://enauczenie.pg.edu.pl/moodle/course/view.php?id=36308">https://enauczenie.pg.edu.pl/moodle/course/view.php?id=36308</a>                                     |  |
| Example issues/<br>example questions/<br>tasks being completed   |   |  |  |
| Work placement   | Not applicable  |  |  |