1. Subject name / subject module: **Analog Circuits**
2. Lecture language: **English**
3. **The location of the subject in study plans:**
   - Area or areas of the studies: Computer Engineering and Mechatronics
   - Degree of the studies: **1st degree studies**
   - Field or fields (implementation of effects standard): **Mechatronics**
4. Supervision of subject implementation:
   - The Institute / Another unit: **Institute of Informatics and Mechatronics**
   - The person responsible for the subject: **Grad Piotr, dr inż.**
   - People cooperating in the development of the programme of the subject:
5. The number of hours and forms of teaching for individual study system and the evaluation method

| Teaching activities with the tutor | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mode of study | Form of classes | | | | | | | | | | | | | | | | | | | | | Total |
| | | SOW | ECTS | Laboratory work | SOW | ECTS | ... | SOW | ECTS | ... | SOW | ECTS | ... | SOW | ECTS | ... | SOW | ECTS | ... | SOW | ECTS | ECTS |
| Full-time studies | | | | 32 | 43 | 3 | | | | | | | | | | | | | | | | 3 |
| Part-time studies | | | | | | | | | | | | | | | | | | | | | | |
| Credit rigor | ... | | | final grading | | | | | | | | | | | | | | | | | | |

6. Student workload – ECTS credits balance
   *1 ECTS credit corresponds to 25-30 hours of student work needed to achieve the expected learning outcomes including the student's own work*

| **Activity**<br>(please specify relevant work for the subject) | **Hourly student workload (full-time studies/part-time studies)** |
|---|---|
| Participation in laboratory classes | **32** |
| Independent study of the subject | **41** |
| Participation in an exam / graded assignment / final grading | **2** |
| Total student workload (TSW) | **75** |
| ECTS credits | **3** |
| * Student's workload related to practical forms | **75** |
| Student's workload in classes requiring direct participation of academic teachers | **32** |

7. Implementation notes: recommended duration (semesters), recommended admission requirements, relations between the forms of classes:

   Electronics

   Recommended duration of the subject is taken from the course plan.
8. Specific learning outcomes – knowledge, skills and social competence

| **Specific learning outcomes for the subject** | | **Form** | **Teaching method** | **Methods for testing of (checking, assessing) learning outcomes** |
|---|---|---|---|---|
| **Outcome symbol** | **Outcome description** | | | |
| **Knowledge** | | | | |
| **K_W05** | **A student possesses sufficient knowledge of electronics, and electrical engineering, necessary to understand, at an advanced level, the complex dependencies in analog electronics and to apply this knowledge in practice through the use of appropriate metho** | **Laboratory work** | **inquiry methods** | **Laboratory tasks, activity during classes** |
| **K_W08** | **A student possesses adequate theoretical and practical knowledge on topics related to the design of analog systems.** | | | |
| **Skills** | | | | |
| **K_U15** | **A student possesses sufficient skills to select and use appropriate methods, components, and tools - in accordance with the given specification - to design and implement a** | **Laboratory work** | **inquiry methods, expository methods** | **Laboratory tasks, activity during classes** |

| | | | | |
|---|---|---|---|---|
| | **simple device or system that requires the use of analog signals and circuits.** | | | |

**9.** Assessment rules / criteria for each form of education and individual grades

| | | | |
|---|---|---|---|
| **0% - 50%** | ndst | **81% - 90%** | db |
| **51% - 70%** | dst | **91% - 93%** | db+ |
| **71% - 80%** | dst+ | **94% - 100%** | bdb |

| Activity | Grades | Calculation | To Final |
|---|---|---|---|
| **Laboratory tasks** | **Example: db; bdb; bdb; db (4; 5; 5; 4)** | **4 * 25% + 5 * 25% + 5 * 25% + 4 * 25% = 4.5** | **4.5** |

**10.** The learning contents with the form of the class activities on which they are carried out

**(Laboratory work)**

**1. The passive components RLC. RC and CR frequency characteristics. Semiconductors - self-existence and insolent. Bipolar transit. Polarisation systems of a bipolar transistor. Small Signal Replacement Diagrams. EC, WB, WC Amplifiers. Current sources.**

**2.Unipolar transients JFET and MOSFET: Principle of operation, basic parameters and static characteristics. Polarisation systems of unipolar transistor. WS, WG, and WD Amplifiers. Field Transistors Applications**

**3.Optoelectronics instruments: LED, Photo Resistor, Photodiode, Phototransistor, Tranoptor. Sensors for non-electrical quantities such as temperature, force, acceleration, etc.**

**4.Tires, triacs. Basic electrical systems**

**5.elementary feedback theory. The effect of negative feedback on the gain strength and frequency response of the amplifier. Amplifier stability. Power amplifiers: Class division, efficiency, distortion.**

**6. Integrated operational amplifier: An ideal amplifier and a real amplifier. Operating amplifier basic operating systems: Reversing amplifier, non-conducting amplifier, totalization, subtraction, integration circuit, differential unit, first row low-pass filter, PI, PD, PID, voltage controlled current source. Analogue Comparators. Measuring amplifiers.**

**7.Rectangular and triangular run generator. LC and RC sinusoidal generators, generation conditions.**

**8. Compensating stabilisers - operating principle. Converters and pulse stabilisers - operation**

**11.** Required teaching aids

Laboratory classes - specialist laboratory

**12.** Literature:

**a.** Basic literature:

1. Scherz Paul, Monk Simon; Practical electronics for inventors; ISBN 978-1-25-958754-2; McGraw - Hill Education 2016

2. Horowitz Paul, Hill Winfield; The art of electronics; ISBN 978-0-521-80926-9; Cambridge University Press 2016

**a.** Supplementary literature:

1. Hugo Alexandre de Andrade Serra, Nuno Paulino; Design of Switched-Capacitor Filter Circuits using Low Gain Amplifiers; ISBN 978-3-319-11791-1; Springer, Cham 2015

2. Esteban Tlelo-Cuautle; Integrated Circuits for Analog Signal Processing; ISBN 978-1-46 Springer, New York, NY 2013

3. Ulrich Tietze, Christoph Schenk, Eberhard Gamm; Electronic Circuits; ISBN 978-3-540-78655-9; Springer, Berlin, Heidelberg 2008

**b.** Internet sources:

1. SparkFun Tutorials - learn.sparkfun.com

2. Electronics Notes - www.electronics-notes.com

3. Electronic Design - www.electronicdesign.com

4. EE Times - www.eetimes.com

5. EDN - www.edn.com

6. Analog Filter Wizard - tools.analog.com/en/filterwizard

7. TI Filter Design Tool - www.ti.com/design-resources/design-tools-simulation/filter-designer.html

**13.** Available educational materials divided into forms of class activities (Author's compilation of didactic materials, e-learning materials, etc.)

**14.** Teachers implementing particular forms of education

| Form of education | Name and surname |
|---|---|
| 1. Laboratory classes | Grad Piotr, dr inż. |