**COURSE UNIT (MODULE) DESCRIPTION**

| Course unit (module) title | Code |
|---|---|
| **Applied Electronics II** | |

| Lecturer(s) | Department(s) where the course unit (module) is delivered |
|---|---|
| **Coordinator: doc. Gintaras Tamošauskas**<br><br>**Other(s):** | |

| Study cycle | Type of the course unit (module) |
|---|---|
| First (bachelor studies) | Arbitrary |

| Mode of delivery | Period when the course unit (module) is delivered | Language(s) of instruction |
|---|---|---|
| Auditorium/ laboratory work | IV (spring) semester | Lithuanian/English |

| Requirements for students | |
|---|---|
| **Prerequisites:**<br>"Electricity and Magnetism" or similar general physics course., Applied Electronics I | **Additional requirements (if any):** |

| Course (module) volume in credits | Total student's workload | Contact hours | Self-study hours |
|---|---|---|---|
| 5 | 140 | 64 | 76 |

| Purpose of the course unit (module): programme competences to be developed | | |
|---|---|---|
| To expand the knowledge in applied electronics and develop practical ability in creation and analysis of electronic circuit, expand theoretical knowledge in integrated circuits, power sources (AC-DC, DC-DC voltage supply), electronic signal processing. To acquire practical skills in soldering and design of printed circuit boards. Acquired skills will let student to independently combine modules of electronic circuits, analyse electronic circuit systems, detect failures of circuits – to obtain knowledge required for practical work expanding boundaries of specialization. | | |
| **Learning outcomes of the course unit (module)** | **Teaching and learning methods** | **Assessment methods** |
| Ability of the student to apply theoretical knowledge for the investigation of properties of devices and electronic circuits; ability to understand the causes of the problems and solution possibilities, ability to independently plan, organize and solve problems linked with electronic schemes and devices. (1.1-1.3) | Laboratory works/ project | Control questions, evaluation of results, reports and conclusions. |
| Acquisition of theory knowledge required for solution of practical problems in electronics; ability to understand the literature about electronics, to | Lectures | Exam in written form. |

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|---|---|---|
| exchange information and to present results; ability to understand, interpret and apply knowledge in electronics field; acquisition of knowledge required for understanding the operating principles of the circuits (2.1) | | |
| Ability to apply printed circuit board (PCB) design software (2.1) | Laboratory works/ project | Evaluation if student is able to design independently the printed circuit boards using computer software. |

| **Content: breakdown of the topics** | **Contact hours** | | | | | | | **Self-study work: time and assignments** | |
|---|---|---|---|---|---|---|---|---|---|
| | Lectures | Tutorials | Seminars | Exercises | Laboratory work | Internship/work placement | **Contact hours** | **Self-study hours** | **Assignments** |
| 1. Soldering: solders, soldering irons, their accessories, cleaning parts, soldering and unsoldering, soldering to printed circuit boards. Surface mount elements and wired elements positioning and soldering peculiarities.<br>*Laboratory works: see the last row of the table (Project). | 4 | | | | * | | **4** | **2** | Course repetition for exam |
| 2. Printed circuit boards (PCBs): basic printed circuit board routing considerations, general purpose analog and digital PCBs, peculiarities of high performance analog and high speed digital PCBs, fabrication of printed circuit boards. Automated and manual routing advantages and disadvantages.<br>Breadboards: structure, use examples. | 4 | | | | | | **4** | **2**** | Repetition for exam. ** Hours for the project - see "Project" at the end of the table |
| 3. Electronic design automation (EDA) suites:<br>Eagle PCB design software: schematic editor and capture, layout editor, autorouter. Possibilities of free and full versions.<br>Open Source EDA Suite: KiCAD overview. | 4 | | | | | | **4** | **2** | Course repetition for exam |
| 4. AC-DC conversion using transformer-based and switched power supplies. Transformer vs Switching. DC-DC conversion: buck, boost converters, voltage dependencies on PWM signal parameters, linear and flyback regulators. | 4 | | | | | | **4** | **2** | Course repetition for exam |
| 5. Sensor signal amplification and conditioning: bridge circuits and differential signal amplification, high impedance sensors, temperature measurements, photodiode signal amplification. Applications of instrumentation amplifiers. | 6 | | | | | | **6** | **2** | Course repetition for exam |
| 6. Active op-amp based filters: low-, high-, band-, all-pass filters, notch (bandreject) filters. Second order filters based on multiple feedbacks. | 4 | | | | | | **4** | **2** | Course repetition for exam |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 7. Analog multiplication and lock-in detection: analog multiplication basics, operation of Gilbert cell, op-amp based logarithmic, summing and exponential amplifiers, arithmetic functions using op-amps, modulators and demodulators, synchronous (lock-in) detection. | 6 | | | | | | **6** | **2** | Course repetition for exam |
| 8. Project (design, production and testing of the working circuit): design of the circuit, assembly and validation of the test (sub-)circuit(s) in a breadboard, design and production of the PCB, soldering, validation of performance in the lab. Typical circuits (different for each team): amplifiers, power supply circuits, pulse and sine wave generators, simple lock-in amplifier, modulator/demodulator circuits. | | | | | 32 | | **32** | **64** | Design of the unique circuit for practical application. Creation of the circuit and testing. Presentation of the report. |
| **Total** | **32** | | | | **32** | | **64** | **76** | |

| **Assessment strategy** | **Weight,%** | **Deadline** | **Assessment criteria** |
|---|---|---|---|
| Project | 40 | During the semester | Ability to explain operating principles of the circuit, rationality of the design, achievement of the correct operation of the circuit, quality of the report. |
| Test | 10 | End of the semester | 10 questions with multiple choices. Correct choice adds 1 point, incorrect choice subtracts 1 point. It is possible not to answer the question. Final score is multiplied by the weight coefficient. |
| Exam (written form) | 50 | During the exam session | 5 open questions. Assessment of answer particularity, consistency and mistakes. |

| **Author** | **Year of publication** | **Title** | **Issue of a periodical or volume of a publication** | **Publishing place and house or web link** |
|---|---|---|---|---|
| **Compulsory reading** | | | | |
| Keith Brindley | 2011 | Starting Electronics, | Fourth Edition | Newnes; 4 edition (September 23, 2011) |
| Walt Jung, Editor | 2004 | Op Amp Applications Handbook | | Newnes; 1 edition (December 6, 2004) |
| Ian Sinclair | 2011 | Electronics Simplified Previously published as Electronics Made Simple | Third edition | Newnes; 3 edition (May 31, 2011) http://dx.doi.org/10.1016/B978-0-08-097063-9.10022-6 |
| **Optional reading** | | | | |
| Jon Varteresian | 2002 | Fabricating Printed Circuit Boards | | Elsevier Science (USA) |
| Keithley, A Tektronix company | - | Low Level Measurements Handbook | 7th Edition | http://www.tek.com/sites/tek.com/files/media/document/resources/LowLevelHandbook_7Ed.pdf |