**COURSE UNIT (MODULE) DESCRIPTION**

| Course unit (module) title | Code |
|---|---|
| **Applied electronics 1** | |

| Lecturer(s) | Department(s) where the course unit (module) is delivered |
|---|---|
| **Coordinator: prof. Vincas Tamošiūnas**<br><br>**Other(s): dr. Linas Minkevičius** | Faculty of Physics |

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

| Mode of delivery | Period when the course unit (module) is delivered | Language(s) of instruction |
|---|---|---|
| Lectures, seminars, laboratory works | III (autumn) semester | Lithuanian/English |

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

| Course (module) volume in credits | Total student's workload | Contact hours | Self-study hours |
|---|---|---|---|
| 5 | 133 | 64 | 69 |

| Purpose of the course unit (module): programme competences to be developed | | |
|---|---|---|
| To provide knowledge of applied electronics and ability to: apply theoretical knowledge for the development of electronic circuits with required properties; efficiently analyze information in literature sources about electronics; apply modern computer-based simulations of electronic circuit performance; explain the operation of electronics circuit(s) based on semiconductor and general physics knowledge. | | |
| **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 (1.1, 1.2) | Laboratory works | Control questions, evaluation of results, reports and conclusions. |
| Ability to apply modern electronic circuit simulation methods, for example, within LTSpice software package (2.4) | Seminars in computer classes | Evaluation if student is able to simulate independently the operation of the given circuit. |
| Acquisition of theory knowledge required for solution of practical problems in electronics(1.3); ability to understand the literature about electronics, to exchange information and to present results (2.2); ability to understand, interpret and apply knowledge in electronics field ; acquisition of knowledge required for | Lectures | Multiple choice test, exam in written form. |

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| understanding the operating principles of the circuits (3.2) | | |

| Content: breakdown of the topics | Contact hours | | | | | | | Self-study work: time and assignments | |
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| | Lectures | Tutorials | Seminars | Exercises | Laboratory work | Internship/work placement | **Contact hours** | **Self-study hours** | **Assignments** |
| 1. Introduction. History of electronics and current directions of research. Major circuit components and their marking. Laboratory works: Introduction with all work stands and equipment. Work safety. | 1 | | | | 4 | | **5** | | |
| 2. Basic circuits and methods of analysis. Kirchhoff's circuit laws, Thévenin's and Norton's theorems. Voltage divider, RC, RL, resonant circuits. Laboratory work: RC and RL circuit. Laboratory work defence. Seminars: get familiar with LTSpice circuit simulation program and to simulate the basics circuits. | 3 | | 2 | | 4 | | **9** | **10** | Preparation for laboratory works, reports writing. Repetition for exam. |
| 3. Diodes and their applications. Introduction to semiconductors, valence and conduction bands, semiconductor doping. p - n junction its' current–voltage curve and capacitance. Half- and full- wave rectification circuits, Zener diodes. Other applications of diodes. Laboratory work: rectification circuit and Zener diode. Laboratory work defence. | 2 | | | | 4 | | **6** | **8** | Preparation for laboratory works, reports writing. Repetition for exam. |
| 4. Transistors and amplifiers. Bipolar transistor, field effect transistors and amplifier stages with them. A, B, AB class amplifiers, their properties, limitations and power. Laboratory work: Bipolar transistor or field effect transistors and amplifier circuit. Frequency dependence of gain and phase of the transistor amplifier. Laboratory work defence. Seminars: Amplifiers circuit simulation using LTSpice program. | 6 | | 2 | | 4 | | **12** | **14** | Preparation for laboratory works, reports writing. Repetition for exam. |
| 5. High-power applications. Switching with transistors and operation of inverter circuits. High-power MOSFET, thyristors, application peculiarities of silicon switched rectifiers and diodes. Power supplies and DC-DC conversion. | 2 | | | | | | **2** | **4** | Repetition for exam. |
| 6. Feedback role in amplifiers and generator. Dependence of amplifier properties on the feedback. Amplitude and phase balance conditions for signal generation. Wien bridge oscillator. Generator circuits based on op-amps. Transistor-based generators. Laboratory work: two-stage RC - generator. Laboratory work defence. Seminars: | 3 | | 2 | | 4 | | **9** | **10** | Preparation for laboratory works, reports writing. Repetition for exam. |

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| feedback influence simulation in amplifiers circuits using LTSpice. | | | | | | | | | |
| 7. Applications of operational amplifiers (op-amps). Properties of op-amps and simplified rules for the analysis of op-amp based circuits. Comparator, inverting and non-inverting amplifiers, differential amplifier, electronic integrator and differentiator circuits, active filters with op-amps. Laboratory work: Feedback in op-amp circuits. Laboratory work defence. Seminars: op-amps circuits' simulation using LTSpice program. | 9 | | 2 | | 4 | | **15** | **14** | Preparation for laboratory works, reports writing. Repetition for exam. |
| 8. Pulse width modulation (PWM) and their application in D class amplifiers. PWM signal generation using comparators. | 2 | | | | | | **2** | **3** | Repetition for exam. |
| 9. Circuits for digital electronics. Base-2 numeral system, basic operations of Boolean algebra and circuits for their implementation. | 1 | | | | | | **1** | **2** | Repetition for exam. |
| 10. Analog to digital (ADC) and digital to analog (DAC) conversion and information transmission. ADC and DAC conversion circuits. | 1 | | | | | | **1** | **2** | Repetition for exam. |
| 11. Optoelectronic devices. Light emitting diodes, photodiodes, data transmission through fiber optics systems. | 2 | | | | | | **2** | **2** | Repetition for exam. |
| **Total** | **32** | | **8** | | **24** | | **64** | **69** | |

| **Assessment strategy** | **Weight,%** | **Deadline** | **Assessment criteria** |
|---|---|---|---|
| Laboratory work rating | 30* | All course | Preparation to answer theoretical questions, quantity of errors in circuit connection, the quality of the work description, ability to describe the results. Evaluation in 10 scores system, the final score is multiplied by the weight coefficient.<br>* It is obligatory to finish all laboratory works. |
| Seminars rating | 10 | All course | Ability to understand and accomplish the tasks during the seminars |
| Test | 10 | End of the course | 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** |
|---|---|---|---|---|
| **Compulsary reading** | | | | |
| D. E. Eggleston | 2011 | Basic electronics for scientists and engineers | | Cambridge University Press, (yra MKIC Technologijos mokslų skaitykloje) |
| S.M. Sze | 2007 | Physics of semiconductor devices | | Wiley Interscience (yra MKIC Technologijos mokslų skaitykloje). |
| **Optional reading** | | | | |
| Keith Brindley | | Starting Electronics (Fourth | | Newnes; 4 edition |

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| | | Edition) | | (September 23, 2011) http://dx.doi.org/10.1016/B978-0-08-096992-3.00023-8 |
| Ian Sinclair | | 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 |
| Paul Scherz, Simon Monk | | Practical Electronics for Inventors, Fourth Edition | | McGraw-Hill Education TAB; 4 edition (March 24, 2016) |
| | | Electronics-Tutorials | | http://www.electronics-tutorials.ws/ |