JOSIP JURAJ STROSSMAYER UNIVERSITY OF OSIJEK

FACULTY OF ELECTRICAL ENGINEERING, COMPUTER SCIENCE AND INFORMATION TECHNOLOGY OSIJEK

Proposal for Amendments

to the Undergraduate University Study Programme in Electrical Engineering and Information Technology

Osijek, 2022

Table of Contents

1. INTRODUCTION

The undergraduate university study programme in Electrical Engineering and Information Technology has been carried out at the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek since the academic year 2005/2006.
Taking into account the interests and the needs of the job market, the broader social community, student interests, as well as scientific promotion of staff who could participate in the teaching process, we have decided to propose amendments to the study programme.

With these amendments, students who enrol in the undergraduate university study programme in Electrical Engineering and Information Technology would be able to opt for one of the following two branches, and a separate admission quota will be defined for each of these two branches:
ET – Electrical Engineering
IKT – Information and Communication Technology

1.1. Basic information about the higher education institution (name and address of the higher education institution, phone number, email address, web address).

Name of the higher education institution:
Josip Juraj Strossmayer University of Osijek
Faculty of Electrical Engineering, Computer Science and Information Technology Osijek
Address:
Kneza Trpimira 2b
31 000 Osijek

Phone:
+385 31 224 600

Email address:
ferit@ferit.hr

Web address:
http://www.ferit.unios.hr

1.2. Name of the body that authorised the launch of amendments to the study programme (e.g. management boards, teachers in higher education institution councils, etc.)? Attach proof thereof.

The Faculty Council of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek, Josip Juraj Strossmayer University of Osijek, adopted the "Proposal for Amendments to the Undergraduate University Study Programme in Electrical Engineering and Information Technology" at its 270th session held on 8 February 2022 (the Faculty Council decision is attached in Appendix 7.1).

1.3. List of teachers who participated in the drafting of the study programme proposal. Add their titles and scientific fields they are elected in.

Tomislav Matić, PhD, Full Professor
Technical Sciences/Electrical Engineering
Danijel Topić, PhD, Associate Professor
Technical Sciences/Electrical Engineering

Ivan Vidović, PhD, Assistant Professor
Technical Sciences/Computer Engineering

Snježana Rimac-Drlje, PhD, Full Professor
Technical Sciences/Electrical Engineering

Damir Šljivac, PhD, Full Professor
Technical Sciences/Electrical Engineering

Željko Hederić, PhD, Full Professor
Technical Sciences/Electrical Engineering

Goran Martinović, PhD, Full Professor with Tenure
Technical Sciences/Computer Engineering

Dražen Slišković, PhD, Full Professor
Technical Sciences/Fundamental Technical Sciences

Tomislav Rudec, PhD, Assistant Professor
Natural Sciences/Mathematics

Irena Galić, PhD, Associate Professor
Technical Sciences/Computer Engineering

2. INSTITUTIONAL REQUIREMENTS

2.0. The study programme proposal must contain a comparability analysis of the proposed study programme with related accredited study programmes in the Republic of Croatia and other countries in the European Union, which must contain minimum institutional requirements.

The proposed undergraduate university study programme in Electrical Engineering and Information Technology is largely based on the current undergraduate university study programme, which preserves the initial comparability with the quality of related accredited study programmes in the Republic of Croatia and in the European Union countries. One of the main reasons for initiating the proposed amendments to the undergraduate university study programme in Electrical Engineering and Information Technology is the implementation of the project "Application of the Croatian Qualifications Framework for University Study Programmes in the Field of Electrical Engineering – HKO-ELE", in which all those higher education institutions participate that conduct university study programmes in the field of electrical engineering in the Republic of Croatia. Within the framework of the project, four occupational standards and three qualification standards were proposed. All partner institutions participating in the project have harmonised their undergraduate university study programmes in the field of electrical engineering with the proposed qualification standard "Bachelor of Electrical Engineering and Information Technology". The aforementioned harmonisation of study programmes at all partner institutions (Faculty of Electrical Engineering, Computer Science and Information Technology Osijek, Faculty of Electrical Engineering and Computing Zagreb, Faculty of Engineering Rijeka, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture Split, and University of Dubrovnik) ensured that all study programmes include all sets of compulsory learning outcomes of the proposed qualification standard, making in this way the undergraduate university study programme in Electrical Engineering and Information Technology entirely comparable to related accredited study programmes in Croatia.

The study programme is comparable in terms of content and qualifications to undergraduate university study programmes conducted at Croatian universities:

- **Undergraduate university study programme in Electrical Engineering and Information Technology at the Faculty of Electrical Engineering and Computing, University of Zagreb (https://www.fer.unizg.hr/studiji/fer3/eit). The learning outcomes of the courses in the proposed undergraduate study programme are largely comparable to the learning outcomes of the following courses:**

  - Digital Logic
  - Linear Algebra
  - Mathematical Analysis 1
  - Introduction to Programming
  - Communication Skills
  - Physics
  - Mathematical Analysis 2
  - Object-Oriented Programming
  - Fundamentals of Electrical Engineering
  - Electronics 1
  - Mathematical Analysis 3
  - Electrical Measuring Techniques
  - Signals and Systems
  - Probability and Statistics
  - Automatic Control

- Communication Systems

- **Undergraduate university study programme in Electrical Engineering and Information Technology at the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split (https://www.fesb.unist.hr/studiji/preddiplomski-studij-eit/). The learning outcomes of the courses in the proposed undergraduate study programme are largely comparable to the learning outcomes of the following courses:**

  - Mathematics 1
  - Fundamentals of Electrical Engineering 1
  - Computers and Programming
  - Communication Skills
  - Physics 1
  - Mathematics 2
  - Digital Electronics
  - Fundamentals of Electrical Engineering 2
  - Programming
  - Electrical Measurements
  - Mathematics 3
  - Probability and Statistics
  - Electric Machines
  - Elements of Electrical Power Switchgears
  - Power Electronics
  - Elements of Industrial Automation
  - Communication Systems and Protocols
  - Object-Oriented Programming
  - Automatic Control 1
  - Pulse and Digital Circuits

- **Undergraduate university study programme in Electrical Engineering at the Faculty of Engineering, University of Rijeka (http://www.riteh.uniri.hr/media/filer_public/26/63/26637de3-a1bc-42ac-a378-4fa5cb928d09/tfr_psvst_elektrotehnike_2021.pdf). The learning outcomes of the courses in the proposed undergraduate study programme are largely comparable to the learning outcomes of the following courses:**
  - Mathematics I
  - Physics I
  - Fundamentals of Electrical Engineering I
  - Mathematics II
  - Fundamentals of Electrical Engineering II
  - Programming
  - Measurements in Electrical Engineering
  - Electronics I
  - Digital Electronics
  - Electric Machines
  - Power Electronics
  - Signals and Systems
  - Electric Drives

In addition, this study programme is comparable to undergraduate university study programmes carried out at European universities (for a more detailed comparison, see 3.21):

- Technical University of Kaiserslautern, study programme "Electrical and Computer Engineering": https://modhb.uni-kl.de/mhb/FB-EIT/cos-685/
- Technical University of Wien, study programme "Electrical Engineering and Information Technology": https://tiss.tuwien.ac.at/curriculum/public/curriculum.xhtml?dswid=7885&dsrid=519&key=58908
- University of Bremen, study programme "Electrical Engineering and Information Technology": https://www.uni-bremen.de/en/studies/orientation-application/study-programs/dbs/study/4?cHash=3dba962e90bc610bc3f1c01ff9525b1b
- University of Óbuda, Budapest, Kandó Kálmán Faculty of Electrical Engineering: https://kvk.uni-obuda.hu/index.php?q=bsc-kepzes-mintatantervei-d-tanterv

The study programmes are entirely comparable because they last for three years, students acquire the same number of ECTS credits (180), and the academic title Bachelor of Electrical Engineering and Information Technology is entirely comparable in both the Republic of Croatia and the European Union countries. Comparability is also evidenced by successful incoming and outgoing mobility within the framework of Erasmus mobility programmes (see 3.24.), which will be continued because the basic assumptions of compliance with the Bologna Process have not changed.

In addition to other teachers of the Faculty, the quality of the teaching process is ensured by a total of 64 teachers and associates affiliated with the following six departments, who will teach most of the classes:

- **Department of Software Engineering**, which consists of the Chair of Programming Languages and Systems and the Chair of Visual Computing.
- **Department of Computer Engineering and Automation**, which consists of the Chair of Computer Engineering and the Chair of Automation and Robotics.
- **Department of Core Courses**, which consists of the Chair of Mathematics, Physics and Mechanical Engineering and the Chair of Humanities and Social Sciences.
- **Department of Electromechanical Engineering**, which consists of the Chair of Fundamentals of Electrical Engineering and Measurements, the Chair of Electric Machines and Power Electronics, and the Electric Machines and Hybrid Electric Drives Laboratory.
- **Department of Communications**, which consists of the Chair of Radiocommunications and Telecommunications, the Chair of Electronics and Microelectronics, the Chair of Multimedia Systems and Digital Television, and the Laboratory for High Frequency Measurements.
- **Department of Power Engineering**, which consists of the Chair of Power Plants and Energy Processes, the Chair of Power Systems and Substations, and the Electromagnetic Compatibility Laboratory.

Within these departments, high-quality computer, laboratory, measuring, and simulation equipment is provided in a series of teaching laboratories that have already been established and that will be used for teaching purposes. These laboratories are constantly evolving and they include the Electric Machines and Drives Laboratory, the Power Electronics Laboratory, the Electrical Measurements Laboratory, the Fundamentals of Electrical Engineering Laboratory, the Power Systems Laboratory, the Radiocommunications Laboratory, the Telecommunications Laboratory, the Renewable Energy Sources Laboratory, the Electronics and Microelectronics Laboratory, and the Physics Laboratory (see 7.2).

It should be emphasised that the Commission for Quality Enhancement and Assurance in Higher Education at the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek

continuously monitors student work and assessment, student surveys of the teaching process and teaching staff, as well as other action plans and ongoing activities aimed at improving the quality of education.

This comparison of the proposed undergraduate university study programme in Electrical Engineering and Information Technology leads to a conclusion that this study programme is highly comparable to related study programmes, which will certainly result in better student mobility between the University of Osijek and other Croatian universities and the majority of European universities.

2.1. Has the higher education institution adopted a strategy for its development and individual strategies or action plans, and does it disclose annual reports on their implementation?

The Strategy of Josip Juraj Strossmayer University of Osijek for the period 2021-2030 was adopted at the 2nd session of the Senate of Josip Juraj Strossmayer University of Osijek in the academic year 2021/2022, which was held on 24 November 2021.

The Development Strategy of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek for the period 2016-2020 was adopted at the 184th regular session of the Faculty Council held on 26 January 2016. The Development Strategy of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek for the period 2021-2025 is being developed and will be adopted in the coming period. The Draft Development Strategy of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek for the period 2021-2025 is harmonised with the Strategy of Josip Juraj Strossmayer University of Osijek for the period 2021-2030.

The Development Strategy, *inter alia*, consolidates individual action plans for the teaching process, scientific research, professional development activities, a quality assurance system, and resource development, and provides detailed road maps to all activities.

It is continuously monitored and analysed whether the tasks aimed at achieving the set strategic goals are fulfilled, and the Faculty Council ensures the implementation of the Strategy, *inter alia*, by adopting the plan and report submitted by the Commission for Quality Enhancement and Assurance in Higher Education, and the Dean's Annual Report on the work and operation of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek.

2.2. Describe how the higher education institution has defined and published its standards and regulations on the assessment of the learning outcomes (examination procedures) achieved within the study programmes it carries out, including verification methods related to quality assurance, impartiality, transparency, procedures in cases of appeals and other relevant areas.

The Ordinance on Studies and Studying at Josip Juraj Strossmayer University of Osijek regulates in more detail the rules of assessment of the achieved learning outcomes, i.e. examination procedures (written and oral exams, practical part of the exam, prerequisites, examination periods, a number of exam attempts, etc.), a grade appeal procedure, an exam retake procedure, content, format, and manner of examination record keeping, ensuring transparency in exams, the right to access exam results, and other related matters. The Ordinance on Studies and Studying at Josip Juraj Strossmayer University of Osijek is published on the website of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and is therefore available to the public, especially to current students and aspiring students.

Based on the Criteria for Monitoring and Assessing Students Studying under the Bologna Process of 20 November 2007, the Student Evaluation Criteria were created and published on the Faculty website. The latest version was adopted at the 244th session of the Faculty Council of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek, which was held on 2 June 2020. Pursuant to that version, every teacher is obliged to establish student evaluation criteria for each course in the manner prescribed in the document. The document is available at the following link: https://www.ferit.unios.hr/2021/upisi-i-studiji/dokumenti-za-upise-i-studije#dokument-okviri-kriterija-ocjenjivanja-2020pdf.

The examination criteria for each individual course within study programmes are clearly stated and displayed on related course pages on the Merlin e-learning platform (https://moodle.srce.hr/) as well as on the Faculty website:
https://www.ferit.unios.hr/2021/upisi-i-studiji/preddiplomski-sveucilisni-studiji#opis-elektrotehnika-informacijska-tehnologija.

The learning outcomes for all courses of undergraduate and graduate university study programmes as well as the undergraduate professional study programme of the Faculty were adopted at the 175th regular session of the Faculty Council held on 10 March 2015, within the framework of the Decision on the Compliance of the Study Programmes with the Act on Scientific Activity and Higher Education. In addition to the learning outcomes, the passing thresholds and the share in the final grade are precisely defined for each activity. As stated in 2.20, one of the main reasons for the amendments to the study programme is the implementation of the project "Application of the Croatian Qualifications Framework for University Study Programmes in the Field of Electrical Engineering – HKO-ELE". Within the framework of the project, workshops on learning outcomes were held for teachers, and compulsory and optional sets of learning outcomes were defined for individual qualification standard proposals. The procedures and evaluation examples referring to each set of learning outcomes are specified for each set of learning outcomes in the proposed qualification standards. The aforementioned activities contribute to the verification of the achievement of the learning outcomes.

An important part of quality assurance is the University student survey, which is conducted pursuant to Josip Juraj Strossmayer University of Osijek guidelines. The survey is filled out by full-time students of all years of study. The survey is usually conducted at the end of the academic year. Through survey questions, students evaluate courses, the criteria for assessing student knowledge and work, teacher availability and attitude towards students. The management of the Faculty analyses survey results and takes necessary actions as needed, while aggregated results are presented at the Faculty Council. The Commission for Quality Enhancement and Assurance in Higher Education prepares and sends individual results to every teacher, and in the case of frequent or major complaints by students, the President of the Commission, together with the Dean, talks to and helps certain teachers who need to introduce changes. The results of student surveys are used to verify the fulfilment of necessary conditions laid down by the Rector's Conference for the evaluation of teaching and professional activity in the process of appointing teachers to scientific-teaching and teaching titles.

In addition, the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek conducts a Faculty Survey on Learning Outcomes and ECTS Credits, by means of which student academic workload is evaluated, i.e., the number of working hours spent on mastering individual activities in the course, and thus passing the exam. It is also evaluated to what extent the teachers taught content provided for by the study programme and how much the individual forms of teaching contributed to the successful adoption of the learning outcomes. These data are compared with the data on the exam pass rate obtained for all courses in all study programmes.

Additional Faculty surveys are as follows:

- a survey of the postgraduate study programme, in which the students evaluate their supervisors, the Vice-Dean for Science and Postgraduate Studies, the Student Administration Office and the quality of information about the study programme, as well as the procedures and processes they encounter in this study programme,
- a survey for graduates i.e., alumni who evaluate their former teachers, the quality of course delivery and how much the Faculty has helped them in getting the desired employment and status within the company;
- a survey for employers who evaluate the quality of graduates employed in their companies and provide further feedback on the direction in which the Faculty should develop, particularly regarding the study programmes carried out by the Faculty, and
- a survey on professional services in which students evaluate their satisfaction with services provided by the Student Administration Office, the Vice-Dean for Education and Student Affairs Office, the Library, and the IT support service.

Furthermore, at its 234th regular session held on 5 November 2019, the Faculty Council of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek adopted the Quality Enhancement and Assurance Handbook for Higher Education, which describes the basic procedures and forms that are necessary to systematically monitor the compliance of activities with the "Standards and Guidelines for Quality Assurance in the European Higher Education Area". The Handbook describes, *inter alia*, the quality enhancement and assurance system, activities in the process of quality assurance and enhancement, as well as quality indicators defined as a quality enhancement measure which are an integral part of internal evaluation adopted by the Faculty Council at the end of the academic year, among which are:

- Number of candidates applying for the study programme/Admission quota;
- Number of students enrolled in the first year of study/Number of graduates per year;
- Total number of students/Number of repeater students;
- Total number of students enrolled in university study programmes/Number of teachers appointed to scientific-teaching titles;
- Total number of students enrolled in professional study programmes/Number of teachers appointed to teaching titles;
- Number of students enrolled in a higher year of study/Number of students enrolled in the first year of study;
- Number of students enrolled in the postgraduate study programme;
- Number of foreign students enrolled in the first year of the postgraduate study programme/Total number of students enrolled in the first year of the postgraduate study programme;
- Number of doctoral dissertations defended;
- Number of research papers published in journals indexed in the Web of Science database/Number of teachers appointed to scientific-teaching titles;
- Citation of papers indexed in the Web of Science database;
- Total impact factor of papers/Number of research papers published in journals indexed in the Web of Science database;
- Number of research papers in the five-year period published in journals that, according to their impact factor, belong to the top 25% of journals within the corresponding subject category (Q1)/Number of research papers published in journals indexed in the Web of Science database in the five-year period;
- Number of competitive research projects approved for funding/Number of competitive research project applications (Croatian Science Foundation, UKF, FP7, Horizon2020);
- Contracted funds for competitive research projects;

- Number of other research projects approved for funding/Number of applications for other research projects (IPA, PoC, contracts with partners from the industry, etc.);
- Contracted funds for other research projects;
- Number of researchers who spent at least two weeks at foreign institutions/Total number of teachers appointed to scientific titles, assistants, postdoctoral researchers and research assistants;
- Outgoing teacher mobility/Number of teachers appointed to teaching and scientific-teaching titles;
- Incoming teacher mobility/Number of teachers appointed to teaching and scientific-teaching titles.

2.3. How do you ensure student participation in all processes related to the quality assurance of the higher education institution?

Within the Faculty Council of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek, there are student representatives elected by the Student Union. Student representatives must make up at least 15% of the members of the Faculty Council. During the decision-making in the Faculty Council, student representatives can exercise a suspensive veto on matters of particular interest to students, such as changes in the study system, quality assurance, proposing study programmes, implementation of syllabi and issues related to student standards.

The student representative is a member of the Ethics Committee, the Committee for Awarding Students, the Commission for Quality Enhancement and Assurance and the Disciplinary Board. The student representative is also appointed to the Working Group for Learning Outcomes and participates in the work of the aforementioned bodies, especially when it comes to revising old or creating new quality-related documents.

In addition to their representatives, students can directly participate in the processes related to quality assurance at the higher education institution, primarily by completing the University Student Survey and the Survey on Learning Outcomes and ECTS Credits, as well as the Survey on Professional Services.

Based on these surveys, in the case of unfavourable results, the Faculty management defines measures to increase quality in the respective cases. Also, the results of the University Student Survey are used to evaluate teaching and professional activities in the appointment process to scientific-teaching and teaching positions required by the Rector's Conference.

2.4. How do you ensure the participation of labour market representatives in the development of the higher education institution?

The management of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek has expressed its interest in strengthening the connection between the industry and the activities organised by the Faculty. Increasing collaboration with the surrounding economy is one of the goals outlined in the draft of the Development Strategy of the Faculty of Electrical Engineering, Computer Science and Information Technology in Osijek 2021–2025.

Therefore, scientific and professional conferences are organised, and interested experts are always invited to participate. Examples include international scientific conferences such as *the International Conference on Smart Systems and Technologies* (https://sst-conference.org/), *the International Conference on Organisation and Technology of Maintenance* (https://oto2021.panon.eu/), and *the Cyber Security Conference* (https://csc.ferit.hr/). Additionally, occasional presentations by the economy and other entities are organised, involving discussions with students and faculty (panel discussions and guest lectures).

The Faculty of Electrical Engineering, Computer Science and Information Technology Osijek makes efforts to establish a link between employers and students through the "Open Doors and Career Day" (DOVIK), which is organised every spring. Efforts are made to present high school and university students with:
• Everything the Faculty offers (primarily through demonstrations in laboratories),
• Everything that companies offer, i.e., where they can find employment after completing their studies, presented through 15-minute company presentations or interesting demonstrations of activities that companies engage in.

A portal for FERIT students and employers, called STUP (https://stup.ferit.hr/), has been established. STUP, which connects our students and employers, was launched on 1 May 2016. Through this portal, companies can directly inform students about opportunities for:

• Employment
• Scholarships
• Completion of their final papers/Master's theses in the company
• Practical training
• As well as publish all other non-commercial content and activities of interest to our students.

Additionally, companies have access to data on students interested in collaboration, and the Faculty informs companies about academic and extracurricular activities they can engage in. The Faculty of Electrical Engineering, Computer Science and Information Technology Osijek also organises and hosts guest lectures held by companies, which employers find highly beneficial and willingly participate in. Hence, on January 2022, the statistics on STUP were as follows:
• 457 companies using the portal, of which
• 62 companies offered practical training
• 254 practical training positions were available, and 191 students completed their practical training in 55 companies.

Companies can publish all other non-commercial content and activities that are of interest to our students. One of the most significant collaborations between the Faculty and companies is established through students' final papers and Master's theses. Companies can propose topics for Master's theses and final papers or act as co-mentors on a topic defined by our faculty mentors.

The connection between the Faculty and labour market representatives is also evident in the awarding of the best students on the occasion of the Faculty Day. For example, in 2021, companies such as HOPS, ATO Inženjering, Institut RT-RK, Plava tvornica d.o.o., Cobe d.o.o., Infobip d.o.o., Siemens d.d., OG Consultancy Services d.o.o., FINA, TEO Belišće d.o.o., Hrvatska gospodarska komora (*the Croatian Chamber of Economy*), Hrvatska komora inženjera elektrotehnike (*the Croatian Chamber of Electrical Engineers*), Belmet 97 d.o.o., Hrvatski telekom d.d., awarded our students.

Faculty teachers are actively engaging in other scientific and professional projects involving collaboration with the industry. As a result, collaboration agreements were signed with the following companies: Državni zavod za mjeriteljstvo (*State Office for Metrology*), Sokol d.o.o., Centar za poduzetništvo, BIOS, MONO, Osijek Danas, Span d.o.o., HEP d.d., Končar – Institut za elektrotehniku d.d (*Končar-Electrical Engineering Institute*)., Adacta d.o.o., Končar – elektronika i informatika d.o.o (*Končar-Electronics and Informatics*)., Siemens, Danieli-Systec d.o.o., VACON AT, Osijek Software City, RT-RK Novi sad, Orqa d.o.o., Huawei Technologies d.o.o.

Additionally, five representatives of the labour market (including the president of the FERIT Alumni Club) are members of the Commission for Quality Enhancement and Assurance in Higher Education, which periodically provides recommendations for study programmes in light of labour market trends.

In terms of collaboration with the industry, accredited laboratories for testing low-frequency and high-frequency electromagnetic fields play a significant role. The Electromagnetic Compatibility Laboratory and the Laboratory for High Frequency Measurements have successfully undergone reaccreditation this year and have carried out a certain number of professional tasks. The specificities of these laboratories are highlighted on the Faculty's website under "Collaboration with the Industry" and in separate promotional flyers for each laboratory: https://www.ferit.unios.hr/2021/znanost-i-suradnja/suradnja-s-gospodarstvom.

2.5. How is the information system for collecting, managing, processing, and reporting on statistical data related to the organisation and implementation of study programmes, and those necessary for quality assurance, structured?

The Higher Education Institutions Information System (ISVU) enables, among other things:

- Generation of ad-hoc reports on student performance, exam pass rates;
- Review of entered data based on specific criteria (e.g., top 10% of students, average exam grades);
- Drawing up reports (periodically required by the Ministry of Science and Education, the University, etc.).

ISVU is a solution for coordinated digitalisation of all higher education institutions in the Republic of Croatia. It is primarily an application for the digitalisation of student-related activities at a higher education institution, allowing the management of databases related to students, teachers, courses, curricula, enrolments, and exams. Additionally, the application supports standard activities of any higher education institution, such as student enrolments, exam registrations, grade entries, issuance of certificates and documents, and it automatically generates summary reports.

Study programmes are also defined through MOZVAG (a module for higher education institutions of the Agency for Science and Higher Education). The MOZVAG system is a standalone web application that facilitates the preparation and assessment of teaching staff and material conditions for the implementation of the study programmes.

In addition, the Faculty has a system called “Mrkve” in which teachers enter reports on conducted classes, which are automatically compared with the syllabus implementation plan. The “Mrkve” system is also linked to the schedule of classes and exams, which is digitally accessible on the Faculty's website: https://www.ferit.unios.hr/2021/studenti/raspored-nastave-i-ispita#predodabir. This schedule includes information on the division of students into smaller groups for various forms of instruction, such as laboratory exercises, etc.

Furthermore, the Faculty utilises the "Mak" system, which facilitates the process of conducting final and Master's exams (including theses) from assigning topics to the automated generation of final reports and forms, as well as grading of students. Through "Mak", it is possible to monitor student progress through the final/Master's exam process, document submission and retrieval, file submissions, as well as evaluation by mentors, the Commission for Master's Exams, and the Committee for Master’s Theses and Final Papers. The system also contains a repository of necessary documents and forms, serves as an information hub for students and teachers, and more.

All teaching materials for individual courses can be found on the e-learning system called Merlin (https://moodle.srce.hr).This platform also serves for communication between teachers and students, where all news related to individual courses is published, about which students receive notifications by email.

Within the scope of the project "Application of the Croatian Qualifications Framework for University Study Programmes in the Field of Electrical Engineering - HKO-ELE", the existing system for creating the implementation plan and monitoring the implementation of study programmes has been improved and adapted. The functionalities have been expanded with the aim of enhancing the monitoring of quality indicators at FERIT. The mentioned improvements and system upgrades enable tracking the following data:

- Data on FERIT teachers:
  - Total number of employees;
  - Total number of employees by academic title;
  - Detailed information by name and surname (name and surname, type of position, employment percentage, and salary coefficient).
- Pass rate data for all exam sessions:
  - For each study programme, each year of the programme, and each course in the programme:
  - Semester of implementation, number of students who took the exam, number of students who passed the exam, percentage, average grade, number of newly enrolled students, total number of enrolled students.
- Data regarding academic performance (for every study programme and year of study, with the option to select the academic year):
  - Number of enrolled students;
  - Number of first-time students in the study year compared to the number of first-time students in the previous study year / number of first-time students in the previous study year;
  - Number of repeaters/total number of enrolled in the same year of study in the previous academic year;
  - Average total number of earned ECTS credits per year of study (the number of students is in the parentheses);
    - Individual student data.

2.6. How are the standards and regulations of the higher education institution defined and published regarding the periodic review of study programmes that involve external experts?

External experts are involved in the process of re-accreditation of the University every five years. The reaccreditation procedure at the Faculty of Electrical Engineering, Computer Science, and Information Technology Osijek was conducted in May 2018. The Accreditation Council of the Agency appointed an expert panel that included external experts. The reaccreditation was carried out based on the prepared self-evaluation, the Ordinance on the Content of Licence and Conditions for Issuing Licence for Performing Higher Education Activity, Carrying Out a Study Programme and Re-accreditation of Higher Education Institutions, as well as the Ordinance on Conditions for Issuing Licence for Scientific Activity, Conditions for Re-accreditation of Scientific Organisations and Content of Licence. The process was also based on Criteria for the Assessment of Quality of Higher Education Institutions within Universities of the Agency for Science and Higher Education.

Based on the re-accreditation evaluation (June 2018) and improvement recommendations, a Commission for the Development of a Quality Improvement Action Plan was established at the Faculty. The initial version of the Action Plan, created by the aforementioned Commission, was thoroughly analysed at a

Quality Commission meeting. The final Action Plan was adopted at the 229th regular session of the Faculty Council held on 11 June 2019.

2.7. How are the standards and regulations for safeguarding students' rights defined and published, especially with regard to informing students, receiving and resolving student complaints, and procedures for protecting students' rights? How are the individuals responsible for students' rights issues (such as the Vice-Dean for Education, Student ombudsmen, Office for Student Affairs, etc.) designated?

Standards and regulations for the protection of students' rights, particularly with regard to informing students, receiving and resolving student complaints, and procedures for protecting students' rights, are defined by the Ordinance on Studies and Studying at Josip Juraj Strossmayer University of Osijek.

A Student Union has been established at the Faculty. The Student Union is a student-elected representative body that protects the interests of students, participates in decision-making processes in the Faculty Council, and represents students in the higher education system. The Student Union has a Statute, adopted by the Faculty Council upon the proposal of the Student Union. The Statute of the Student Union determines the working methods, bodies, composition, election procedures and jurisdiction of each body of the Student Union. It also specifies how the Student ombudsman is appointed, how student representatives are elected to the Faculty bodies, the responsibility of the bodies and members of the Student Union for not fulfilling the tasks entrusted to them related to the work of the Student Union, as well as other matters important for the functioning of the Student Union.

The Student Union elects student representatives to the Faculty Council. Student representatives must constitute 15% of the members of the Faculty Council. During decision-making in the Faculty Council, student representatives have the right of a suspensive veto on matters of particular interest to students such as modifications in the study system, study quality assurance, amendments to study programmes and the implementation of syllabi, and issues related to student standards. The Faculty Council re-examines the issue after the suspensive veto, at the earliest within 8 days. In the repeated decision-making process, the decision is made by a simple majority from the total number of voting members of the Faculty Council, with no suspensive veto power.

The Student ombudsman is appointed by the Assembly of the Student Union upon the proposal of the President of the Student Union. The Student ombudsman receives complaints from students related to their rights, discusses them with the relevant bodies of the Faculty, advises students on how to exercise their rights, and may participate in disciplinary proceedings against students to protect their rights.

The Vice-Dean for Education and Student Affairs is appointed by the Faculty Council upon the proposal of the Dean.

The Disciplinary Board for students consists of a president and two members, one of whom is a student. The Faculty Council appoints and dismisses the president and one member, along with their deputies from the ranks of the teaching staff. Additionally, the Student Union appoints and dismisses one member and their deputy from the ranks of students.

According to the Ordinance on Studies and Studying at Josip Juraj Strossmayer University of Osijek, Article 70, published at https://www.ferit.unios.hr/2021/studenti/zahtjevi-potvrde-i-propisi#dokument-pravilnik-o-studijima-i-studiranju, a student who is not satisfied with the received grade can, within 48 hours after the oral exam/oral part of the exam, or after the announcement of the written exam results, submit a request for retaking the exam before the Examination Committee.

2.8. How are the standards and regulations for the continuing professional development of all higher education institution employees in their respective fields defined and published, and how are reports on their implementation submitted?

Standards and regulations for continuing professional development of all higher education institution employees in their respective fields are defined by the Regulations on Promotion into Scientific Titles, Scientific-teaching and Artistic-teaching Titles, Teaching, Assistant and Professional Titles, and corresponding job positions at Josip Juraj Strossmayer University of Osijek, adopted by the Senate of Josip Juraj Strossmayer University of Osijek and published on the websites of the Faculty and the University.

The Expert Committee for Assessing the Rector's Conference Criteria is a standing expert body of the Faculty Council which assesses the compliance with the requirements prescribed by the Rector's Conference regarding teaching and professional activities in the process of appointing faculty members to scientific-teaching and teaching titles. Additionally, it prepares reports on the verification of the requirements for these appointments.

With the aim of ensuring the quality of pedagogical, psychological and methodological skills for teaching at a higher education level, the Faculty provides all teachers with the opportunity to attend pedagogical-psychological and didactic-methodological training when they are first appointed to a scientific-teaching position. In addition to pedagogical-psychological and didactic-methodological training, continuing education of teachers and associates of the Faculty is ensured through scientific and professional lectures periodically held at the Faculty, as well as through institutional support for visits to foreign scientific and research institutions, conferences, workshops, and other forms of scientific and professional development.

Once a year, education and training records are collected for all employees of the Faculty with the aim of monitoring and planning. Based on the data collected through the form (Appendix IV of the FERIT Quality Manual) that employees submit to the Commission for Quality Enhancement and Assurance in Higher Education, the Commission submits a report to the Dean of the Faculty. The education and training records are used for strategic planning of education and lifelong learning of the Faculty staff. Therefore, the Commission creates two documents each year, i.e. an Education and Training Plan for the next year and a Report on Education and Training for the previous calendar year.

2.9. How is the quality of work of all professional services at the higher education institution ensured, and how is a report submitted?

Through regular communication among employees and professional services, the quality of work provided by professional services is analysed and improved, and, if necessary, appropriate measures are taken.

An important aspect of informing all employees is certainly the Intranet system where all relevant decisions, minutes and documents are published, making it easier for employees to perform their assigned tasks more efficiently.

Moreover, a survey is conducted to evaluate the performance of all professional services within the higher education institution (see 2.2).

3. GENERAL INFORMATION ABOUT THE STUDY PROGRAMME

3.1. Name of the study programme
Undergraduate university study programme in Electrical Engineering and Information Technology

3.2. Provider of the study programme
Josip Juraj Strossmayer University of Osijek, Faculty of Electrical Engineering, Computer Science and Information Technology Osijek

3.3. Type of the study programme
University study programme

3.4. Level (1-professional/2-specialist graduate professional or 1-undergraduate university/2-graduate university/3-postgraduate specialist or postgraduate university)
1- undergraduate university

3.5. Scientific or artistic area
Technical Sciences

3.6. Scientific or artistic field
Electrical Engineering

3.7. Scientific or artistic branch
2.03.01 power engineering
2.03.02 electromechanical engineering
2.03.03 electronics
2.03.04 telecommunications and informatics
2.03.05 radiocommunications
2.03.06 automation and robotics

3.8. Admission requirements
Candidates who have completed a four-year high school education and passed the national high school leaving exam are eligible to enrol in the undergraduate university study programme in Electrical Engineering and Information Technology. Based on high school grades and high school leaving exam results, a ranking list of applicants will be made.

3.9. Duration of the study programme
The undergraduate university study programme lasts for three years (six semesters) and the student is required to earn a minimum of 180 ECTS credits.

3.10. Academic/professional title awarded upon completion of the study programme
Upon completion of the undergraduate university study programme in Electrical Engineering and Information Technology, a student is awarded the academic title of **University Bachelor of Electrical Engineering and Information Technology (Baccalaureus/Baccalaurea).**

3.11. If you are proposing a specialist graduate professional study programme, attach a document on the accredited professional study programme in the same scientific or artistic field.
A specialist graduate professional study programme is not being proposed.

3.12. If you are proposing a graduate university study programme, attach a document on the accredited undergraduate university study programme in the same scientific or artistic field.
A graduate university study programme is not being proposed.

3.13. If you are proposing a postgraduate specialist study programme, attach a document on the accredited graduate university or integrated undergraduate and graduate study programme in the same scientific or artistic field.
A postgraduate specialist study programme is not being proposed.

3.14. If you are proposing a postgraduate university study programme, attach a document on the accredited graduate university or integrated undergraduate and graduate study programme in the same scientific or artistic field.
A postgraduate university study programme is not being proposed.

3.15. Analyse the compliance of the study programme with the strategic goals of the higher education institution
The developmental strategy of the Faculty of Electrical Engineering Osijek 2016-2020 was adopted at the 184th session of the Faculty Council held on 26 January 2016. The strategy of Josip Juraj Strossmayer University of Osijek 2021-2030 was adopted on 24 November 2021 at the 2nd session of the University Senate in the academic year 2021/2022. Based on the University Strategy, the Development Strategy of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek was drafted and is in the process of being adopted. The study programme is aligned with the drafted Strategy.

3.15.1 Mission
The mission of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek is as follows:

- educate experts who will create added value and contribute to the development of the Republic of Croatia with the acquired knowledge and skills in the fields of electrical engineering, computer science and information technology;
- conduct classes based on the knowledge gained in the implementation of competitive scientific projects and projects done in cooperation with companies;
- develop the economy through innovation and technology transfer thus contributing to the development of the society.

3.15.2. Vision

The vision of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek is to be an institution with developed educational and research capacities, ensuring competitiveness with European and global higher education institutions, scientific excellence, and international recognition in the fields of electrical engineering, computer science and information technology, as well as effective transfer of knowledge and new technologies to the economy.

3.16. List the competencies that a student acquires upon completing the proposed study programme and the jobs they are qualified for.

Depending on the branch, upon completion of the Undergraduate university study programme in Electrical Engineering and Information Technology at the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek, students are qualified for the following jobs in the field of electrical engineering and other related scientific fields:

Branch Electrical Engineering:

- Using basic mathematical and physical knowledge, construct a model for solving engineering problems and a procedure for evaluating experimental results in the fields of electrical and computer engineering;
- Apply basic economic knowledge and skills to solve business problems;
- Apply formal and terminological expressions and phrases in both written and oral general and business communication in Croatian and in a foreign language;
- Analyse the operating conditions of different types of electrical machines, and perform electrical and mechanical measurements;
- Analyse design and modes of operation of different types of converters in industrial plants;
- Solve (non)linear and time-(in)variant power networks, conduct electrical measurements in the network and evaluate the obtained results;
- Solve simple problems in steady-state electric and magnetic fields and in electric circuits;
- Develop one's own software solutions by applying operating principles and technologies for developing computer and software systems;
- Develop a model and simulate a specific system by applying the principles and mechanisms of modelling and simulation, and signals and systems theory;
- Analyse different types of energy transformations from primary to useful forms of energy and the impact of these transformations on the environment and climate change;
- Analyse the basic aspects of electricity generation, transmission, distribution, and consumption, and design models and carry out simulations of power flows, short circuits, and stability of specific power systems;
- Apply fundamental knowledge of electrical installations and lighting;
- Analyse and distinguish between different types of communication networks, and the physical and logical structure of modern wired and wireless communication networks;
- Evaluate the basic aspects of communication technologies used in power and industrial systems.

Branch Information and Communication Technology:

- Using basic mathematical and physical knowledge, construct a model for solving engineering problems and a procedure for evaluating experimental results in the fields of electrical and computer engineering;
- Apply basic economic knowledge and skills to solve business problems;
- Apply formal and terminological expressions and phrases in both written and oral general and business communication in Croatian and in a foreign language;
- Solve linear and time-invariant power networks, conduct electrical measurements in the network and evaluate the obtained results;
- Solve simple problems in steady-state electric and magnetic fields and in electric circuits;
- Design amplifiers for a defined frequency band and amplification amount and perform an analysis of their operation;
- Design and evaluate digital circuits and systems based on defined functionalities and features;
- Develop one's own software solutions by applying operating principles and technologies for developing computer and software systems;
- Analyse and evaluate the functionality and efficiency of one’s own software solution;
- Define basic concepts in the field of information theory;
- Analyse and distinguish between different types of communication networks, and the physical and logical structure of modern wired and wireless communication networks;

- Analyse the structure and protocol stack in modern communication networks;
- Analyse and evaluate the spectral characteristics of signals during transmission in the basic and higher frequency bands using fundamental knowledge of communication systems and signals and systems theory;
- Apply appropriate methods and techniques for analysing and calculating simple cases of plane wave propagation, and select and evaluate antennas for use in radiocommunication systems;
- Apply a machine learning model to solve classification and regression problems and develop one's own solutions using unsupervised machine learning methods.

3.17. Describe the mechanism for ensuring vertical mobility of students in the national and international higher education space. If it concerns the first level of professional or university study programmes, indicate which specialist graduate professional study programmes or graduate university study programmes could be pursued at the proposing institution and/or at another higher education institution in the Republic of Croatia.

In Figure 1, a vertical scheme of the study programmes carried out at the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek is shown. University bachelor's degree holders in Electrical Engineering and Information Technology who complete the undergraduate university study programme in Electrical Engineering and Information Technology are eligible to enrol in the Graduate university study programme in Electrical Engineering (branches: Power Engineering or Communications and Informatics) and the Graduate university study programme in Automotive Computing and Communications at the Faculty (see Figure 1). They can also apply for admission to other related faculties at other universities in Croatia and abroad, following the conditions of those institutions. By taking additional coursework, they can also enrol in the Graduate university study programme in Computer Engineering at FERIT.

The implementation of the project "Application of the Croatian Qualifications Framework for University Study Programmes in the Field of Electrical Engineering - HKO-ELE" has ensured the harmonisation of study programmes in the field of electrical engineering with the proposed qualifications standard, thereby facilitating easier vertical mobility of students at the national level.

Outgoing and incoming student mobility in the international arena is ensured during studies through the Erasmus+ International Mobility Programme between the Faculty and about 70 foreign higher education institutions. Furthermore, mobility occurs through IAESTE and other mobility programmes.

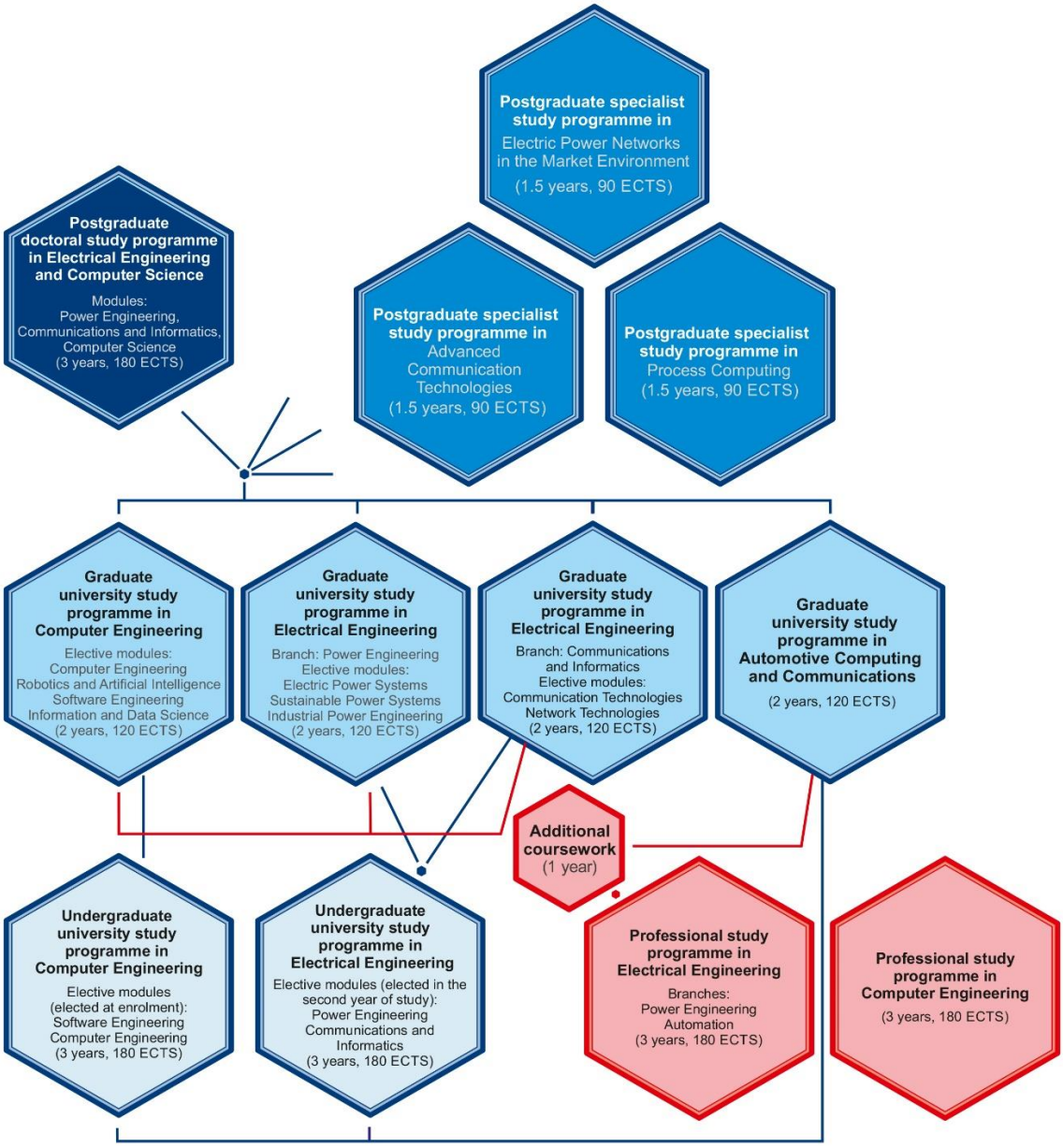

Figure 1. Vertical studying scheme at the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek

3.17.1 Courses students can opt for and enrol in other study programmes

Every academic year, students have the option to choose elective courses offered at Josip Juraj Strossmayer University of Osijek. For example, in the academic year 2021/2022, a total of 49 courses from 17 University constituent units were offered. The list is available at the following link: http://www.unios.hr/wp-content/uploads/2021/07/Odluka-Kolegiji-2122-.pdf

3.17.2. List of courses which can be taught in a foreign language

The list of courses that can be taught in a foreign language can be found in Chapter 4.4. In total, there are 22 courses that can be taught in English.

3.17.3. Criteria and conditions for the transfer of ECTS credits

The Faculty organises and carries out the Erasmus International Mobility Programme, which enables students to spend one part of their studies at a foreign higher education institution and/or undergo practical training, which significantly contributes to their independence, cultural enrichment, proficiency in foreign languages and ability to work in multicultural environments. Implementation and basic principles of incoming and outgoing student mobility, students' rights and obligations, rights and obligations of the University Committee for the Erasmus International Mobility Programme and the institutional Erasmus coordinator, as well as other questions relevant for the implementation of the mobility programme have been specified in the Regulations on the Erasmus Mobility Programme. On the recommendation of the Erasmus coordinator, the Committee for Education and Student Affairs lays down the criteria and conditions for ECTS recognition for students participating in the Mobility Programme.

3.18. Explain the relationship of the proposed professional/university study programme with fundamental and contemporary skills and the profession

The contemporary study programme of electrical engineering and information technology is based on extensive research and development in the fields of natural and technical sciences, as well as on the development of new technologies. This is particularly evident in the development of the electrical, electronic, and IT industries, which are backed by the latest scientific findings in the field of electrical engineering. The market is undoubtedly a driver of development and research in this area and will continue to be a reliable support for further investments in science and research in the field of electrical engineering. This necessitates ongoing monitoring of the latest scientific knowledge through research and development at the Faculty, primarily within the framework of scientific projects under the auspices of the Ministry of Science and Education, through EU projects, and certainly through cooperation and projects with the economy.

It was previously mentioned that the proposed amendments to the undergraduate university study programme in Electrical Engineering and Information Technology are largely based on the implementation of the project " Application of the Croatian Qualifications Framework for University Study Programmes in the Field of Electrical Engineering - HKO-ELE." When developing the occupational standards proposal, which is in line with the Methodology for the Development of Occupational Standards, relevant employers/representatives of the labour market in the field of electrical engineering and information technology in the Republic of Croatia were surveyed about the competencies that students need to acquire upon completion of their studies. In this way, it is ensured that the proposed study programme is connected with fundamental and modern skills and occupational requirements.

Students enrolled in the undergraduate university study programme in Electrical Engineering and Information Technology can receive education in one of the two branches: Electrical Engineering and Information and Communication Technology. Students of both branches acquire competencies in the areas of mathematics, physics, programming, fundamentals of electrical engineering, engineering graphics and documentation, basics of electronics, signals and systems, and communication networks.

The branch Electrical Engineering is designed to educate students in the areas of power engineering and electromechanical engineering, with an emphasis on power grid analysis, energy conversion, the application of engineering materials in electrical engineering, the basics and analysis of electrical machines and drives, fundamentals of power engineering and ecology, basics of power system analysis, measurement basics, automatic control systems, fundamentals of power electronics, electrical

installations and lighting, and communication technologies in electrical engineering. Upon completing the branch Electrical Engineering, students become highly skilled professionals who are capable of keeping up with technological developments in these areas and applying their acquired knowledge to solve engineering problems. They are also qualified to continue their studies at graduate university study programmes. In addition to gaining professional competencies, students also develop communication skills in both their native and foreign languages, and competencies in the basics of business economics.

The branch Information and Communication Technology is designed to educate students in the field of information and communication technologies, with an emphasis on electrical signals measurements, operating systems, algorithms and data structures, digital and analogue electronics, information theory, pulse and digital circuits, databases, object-oriented programming, fundamentals of microcontroller systems, basics of power engineering, theory of electromagnetic fields and waves, communication systems, and introduction to machine learning. Upon completing the branch Information and Communication Technology, students become highly skilled professionals who are capable of keeping up with technological developments in these areas and applying their acquired knowledge to solve engineering problems. They are also qualified to continue their studies at the graduate university study programmes. In addition to gaining professional competencies, students also develop communication skills in both their native and foreign languages, and competencies in the basics of business economics.

3.19. Explain how the study programme is connected to the demands of the local community (economy, entrepreneurship, civil society, etc.).

The connection of the study programme to the needs of the local community is partly described in chapter 2.4, which discusses the involvement of labour market representatives in the development of the higher education institution.

The study programme is expected to meet the requirements of the local community for new jobs, particularly in terms of reducing unemployment (see 3.20).

The labour market in Croatia indicates that graduates from the study programme of Electrical Engineering and Information Technology are very easily employed or typically continue their education at the Master's level, so there are hardly any specialists of the said profile unemployed at the Croatian Employment Service. The Faculty of Electrical Engineering, Computer Science and Information Technology Osijek is the only institution in Eastern Croatia that trains highly educated professionals in the fields of electrical engineering and information technology, which forms the basis for future successful activities but also for the retention and recruitment of highly educated staff and economic growth and development, both of the region and of Croatia as a whole.

Data from both the immediate vicinity and broader regions, including the European Union, the USA, and the rest of the developed world, unequivocally show that professionals who specialise in electrical engineering and information technology have significant employment opportunities and that there is a consistent demand for experts of this profile. Moreover, the trends of growth and development in electrical engineering, computer engineering, and particularly information and communication technologies, along with predictions of the future influx of new technologies and services, indicate an increasing need for such experts. It is expected that this trend will continue, providing a basis for launching study programmes of this profile. Experts who complete the undergraduate university study programme in Electrical Engineering and Information Technology will gain sufficient foundational knowledge to successfully enter the labour market, but also to continue their studies at the graduate study programme. Global experiences show that experts who complete shorter duration studies, such as the undergraduate programme in electrical engineering and information technology, find employment very quickly, both due to the chronic

shortage of educated workforce and due to the specialised nature of certain jobs for which basic professional knowledge, provided by the undergraduate study programme, is sufficient.

Nowadays, electrical engineering and information technology are present in all segments of human life, and without them, it is impossible to imagine the overall social and economic development of modern society, including the development of Croatia. Undoubtedly, electrical engineering and information technology will continue to be the drivers of societal development, which will require highly qualified experts who can meet the challenges of the new era. Highly educated experts in electrical engineering and information technology, who are educated at the Faculty of Electrical Engineering, Computer Engineering and Information Technology Osijek, have found and will undoubtedly continue to find their place in the labour market.

3.20. Attach an analysis of the employability of students after completing the study programme, including the opinion of at least three organisations related to the labour market (e.g., professional associations, employers and their associations, unions, public services) on the alignment of the intended learning outcomes acquired upon completion of the studies with the needs of the labour market.

According to the official data from the Croatian Employment Service at the beginning of January 2022, it is noticeable that the unemployment rate has been very low in recent years. However, it should be noted that almost all students who complete the undergraduate university study programme in Electrical Engineering and Information Technology upgrade to the Master's programme before joining the workforce.

Tables for the undergraduate university study programme in Electrical Engineering and Information Technology:

The number of newly enrolled students in the undergraduate university study programme in Electrical Engineering and Information Technology					
2017	2018	2019	2020	2021	Total
135	130	140	142	137	684

Newly registered with the Croatian Employment Service aged up to 39 years						Newly registered with the Croatian Employment Service aged up to 39 years and employed within 6 months					
2017	2018	2019	2020	2021	Total	2017	2018	2019	2020	2021	Total
13	8	9	12	6	48	6	8	3	7	5	29

Table for the graduate university study programme in Electrical Engineering:

The number of newly enrolled students in the graduate university study programme in Electrical Engineering					
2017	2018	2019	2020	2021	Total
55	60	72	73	79	339

Newly registered with the Croatian Employment Service aged up to 39 years						Newly registered with the Croatian Employment Service aged up to 39 years and employed within 6 months					
2017	2018	2019	2020	2021	Total	2017	2018	2019	2020	2021	Total

63	50	37	33	30	213	50	42	28	31	26	177

It should be pointed out that the actual unemployment rate may be slightly higher than depicted above. Namely, when registering with the Croatian Employment Service, entering the name of the educational institution and the year of graduation is not mandatory.

Positive opinions from at least three organisations related to the labour market are attached in Appendix 7.3.

3.21. Compare the proposed professional/university study programme with foreign accredited study programmes in respected higher education institutions especially in the European Union.

Technical University of Kaiserslautern offers an undergraduate university study programme in Electrical Engineering and Information Technology which covers the following fields:

- Power Engineering
- Electromechanical Engineering
- Information and Communication Technology

Courses that are similar to those offered in the branch Electrical Engineering:

- Higher Mathematics I
- Higher Mathematics II
- Fundamentals of Electrical Engineering I
- Fundamentals of Electrical Engineering II
- Electronics I
- Electrical Measurement Technique I
- Fundamentals of Signals and Systems
- Fundamentals of Electrical Power Engineering
- Fundamentals of Automation
- Fundamentals of Power Electronics
- Electrical Drive Technology I
- Electrical Energy Systems I
- Electrical Energy Systems II
- Fundamentals of High-Voltage Engineering

Courses that are similar to those offered in the branch Information and Communication Technology:

- Higher Mathematics I
- Higher Mathematics II
- Fundamentals of Electrical Engineering I
- Fundamentals of Electrical Engineering II
- Electronics I
- Electronics II
- Electrical Measurement Technique I
- Fundamentals of Signals and Systems
- Programming in C
- Operating Systems
- Microelectronic Circuit and System Design I
- Introduction to Communication Networks
- Communications Theory

Technical University of Wien offers an undergraduate university study programme in Electrical Engineering and Information Technology which covers the following fields:

- Power Engineering
- Electromechanical Engineering
- Information and Communication Technology

Courses that are similar to those offered in the branch Electrical Engineering:

- Mathematics 1 for Electrical Engineering
- Mathematics 2 for Electrical Engineering
- Physics for Students of Electronics and Electrotechnical Engineering
- Electrical Engineering 1
- Electrical Engineering 2
- Signals and Systems 1
- Signals and Systems 2
- Materials
- Measurement and Instrumentation Laboratory
- Technical Electronic
- Electrical Machines and Drives

Courses that are similar to those offered in the branch Information and Communication Technology:

- Mathematics 1 for Electrical Engineering
- Mathematics 2 for Electrical Engineering
- Physics for Students of Electronics and Electrotechnical Engineering
- Electrical Engineering 1
- Electrical Engineering 2
- Signals and Systems 1
- Signals and Systems 2
- Measurement and Instrumentation Laboratory
- Technical Electronic
- Electronic Devices
- Digital Systems
- Data Communications

University of Bremen, Germany offers an undergraduate university study programme in Electrical Engineering and Information Technology which covers the following fields:

- Power Engineering
- Electromechanical Engineering
- Information and Communication Technology

Courses that are similar to those offered in the branch Electrical Engineering:

- Higher Mathematics 1
- Higher Mathematics 2
- Higher Mathematics 3
- Physics for Electrical Engineering 1
- Physics for Electrical Engineering 2
- Basics of Electrical Engineering
- Basic Laboratory Electrical Engineering 1
- Fundamentals of Electrical Engineering
- Basic Laboratory Electrical Engineering 2
- Basics of Energy and Automation Technology

Courses that are similar to those offered in the branch Information and Communication Technology:

- Higher Mathematics 1
- Higher Mathematics 2
- Higher Mathematics 3
- Physics for Electrical Engineering 1
- Physics for Electrical Engineering 2
- Basics of Electrical Engineering
- Basic Laboratory Electrical Engineering 1
- Fundamentals of Electrical Engineering
- Basic Laboratory Electrical Engineering 2
- Basics of Computer Science 1
- Basics of Information and Communication Technology
- Basics of Microsystems Technology and Microelectronics

Obuda University, Hungary offers an undergraduate university study programme in Electrical Engineering which covers the following fields:

- Power Engineering
- Electromechanical Engineering
- Information and Communication Technology

Courses that are similar to those offered in the branch Electrical Engineering:

- Mathematics 1
- Mathematics 2
- Physics 1
- Material Science for Engineers
- Electricity 1
- Electricity 2
- Programming 1
- Technical Documentation
- Measurements 1
- Measurements 2
- Automation
- Communications Technics 1
- Electrical Energetics

Courses that are similar to those offered in the branch Information and Communication Technology:

- Mathematics 1
- Mathematics 2
- Physics 1
- Electricity 1
- Electricity 2
- Programming 1
- Technical Documentation
- Measurements 1
- Measurements 2
- Digital Technics I
- Communications Technics 1
- Digital Technics II
- Electronics Technology

- Embedded Systems
- Signal Processing I

Based on the comparison of the proposed undergraduate university study programme in Electrical Engineering and Information Technology with the previously mentioned programmes, it can be concluded that there is a high level of alignment between the proposed programmes and those reviewed, which ensures the possibility of exchange and flow of students as well as faculty between J.J. Strossmayer University of Osijek and European universities.

3.22. Describe the providers' experience in carrying out the same or similar professional/university study programmes

The undergraduate university study programme in Electrical Engineering and Information Technology has been carried out since academic year 2005/2006.

In less than forty-two years of the Faculty's existence, over 6500 students have earned their degrees:
- pre-Bologna professional study programme in Electrical Engineering: 1065
- pre-Bologna university study programme in Electrical Engineering: 950
- undergraduate university study programme in Electrical Engineering and Information Technology: 856
- undergraduate university study programme in Computer Engineering: 779
- undergraduate professional study programme in Electrical Engineering: 510
- undergraduate professional study programme in Informatics and Computer Engineering: 502
- graduate university study programme in Electrical Engineering: 967
- graduate university study programme in Computer Engineering: 824
- graduate university study programme in Automotive Computing and Communications: 35
- postgraduate doctoral study programme in Electrical Engineering: 83

The amendments to the study programme were proposed based on the implementation of the project " Application of the Croatian Qualifications Framework for University Study Programmes in the Field of Electrical Engineering - HKO-ELE" (https://hko-ele.ferit.hr/), which aimed to develop occupational standards and qualification standards, and to enhance and modernise existing university study programmes in the field of electrical engineering, including information and communication technology. Within the framework of the project, a survey of employers was carried out to align the study programmes with labour market needs.

3.23. If there are any, list the partners outside the higher education system (economy, public sector, etc.) who would participate in the proposed study programme

The proposed graduate university study programme in Electrical Engineering and Information Technology at the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek is based on the results of the project *Application of the Croatian Qualifications Framework for University Study Programmes in the Field of Electrical Engineering - HKO-ELE* and a better connection with the economy and technological development. External associates will participate in the teaching process, practical training and Master's theses as partners whose activities are in the fields of electrical engineering and information technology. This collaboration has already been established through the STUP portal (for more details, see 2.4).

3.24. Write about how your university develops international cooperation

The Faculty of Electrical Engineering, Computer Science and Information Technology Osijek has been cooperating with faculties, universities and research institutions in the country and abroad for a long time.

This cooperation takes place through the outgoing and incoming student, teaching and non-teaching staff mobility as well as research, teaching and professional activities. This primarily involves the exchange and hosting of teachers, scientific training of researchers, conducting research for doctoral disserations, graduate theses and final papers, student internships, attending language courses, research on projects, and other activities. Additionally, there is a direct scientific, teaching and professional cooperation with colleagues abroad.

Since 1985, the Faculty, together with the Hochschule Bremen, University of Applied Science, has been a co-initiator of the conference Science in Practice, which is held alternately at the aforementioned institutions and at the Fachhochschule Würzburg - Schweinfurt, University of Applied Science, Pecs University, Polack Mihally College of Engineering, Pecs, Obuda University, Kando Kalman Faculty of Electrical Engineering, Budapest, and Subotica Technical College of Vocational Studies. In October 2014, the Faculty hosted the 32nd International Conference Science in Practice. There were about 60 participants and 40 presented papers. Also, the Faculty is a co-organiser of the international conference European Conference on Software Architecture (ECSA 2015), which took place in September 2015.

The Faculty is the organiser or co-organiser of several international and domestic conferences. It co-organised the 39th International Conference on Telecommunications and Signal Processing (TSP), which was held from 27 to 29 June 2016 in Vienna. Along with the Centre of Excellence for Computer Vision, (FER Zagreb), the Faculty co-organised the Fifth Croatian Computer Vision Workshop, which was held on 11 October 2016 in Osijek. It co-organised the 40th International Conference on Telecommunications and Signal Processing (TSP), which was held from 5 to 7 July 2016 in Athens.

In order to improve international cooperation and increase the international visibility of scientific work, the Faculty initiated the International Conference on Smart Systems and Technologies (SST). The first such conference was held from 12 to 14 October 2016 in Osijek, under the auspices of IEEE Region 8, IEEE Croatia Section, Croatian branch of CIGRE, i.e. in the period from 2016 to 2021, four more SST conferences were held.

The Faculty of Electrical Engineering, Computer Science and Information Technology Osijek is also the organiser of the international scientific and professional conference Organisation and Technology of Maintenance - OTO. The goal is to point to the importance of maintenance, taking into account the continuous technological progress in all spheres of the economy, infrastructure and public services. OTO began more than 27 years ago at the Faculty of Electrical Engineering in Osijek. We have witnessed the continuous growth of the Faculty as well as the profiling of the OTO group, which has grown into a regional interdisciplinary expert group. In order to maintain continuity upon the association's termination, the Faculty took over the organisation, which has resulted in a large number of authors from the higher education system. OTO represents an opportunity for the direct exchange of experiences of experts from all areas of maintenance with the aim of research and analysis of new methods and procedures.

The Faculty of Electrical Engineering, Computer Science and Information Technology Osijek hosted and organised the 26th International Conference on Systems, Signals and Image Processing IWSSIP 2019. The conference was held from 5 to 7 June 2019, and the goal was to provide researchers and experts with a platform for the development and dissemination in the field of theoretical, experimental and applied signal and image processing. The scientific programme of the IWSSIP 2019 conference was divided into ten sections dealing with contemporary topics in the field of image and video processing, signal processing in electronics, processing and analysis of biomedical signals and images, image and video processing for autonomous driving, machine learning and signal processing in communication networks and systems. The programme included a preliminary lecture, five invited lectures by world-renowned

scientists, an industrial section, and 46 research papers by 150 authors from 25 countries and five continents.

Since 2015, the Faculty has been a partner institution in the Scientific Centre of Excellence for Data Science and Cooperative Systems, the first centre of excellence in the field of technical sciences in Croatia, whose purpose is to advance Croatian science and strengthen its inclusion in the European Research Area. The centre consists of two research units - Research in Data Science and Advanced Cooperative Systems Research (ACROSS). The former research unit brings together 49 scientists from nine collaborating institutions. The ACROSS research unit brings together 32 leading experts from 7 collaborating Croatian institutions.

Important international cooperation was achieved by including the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek in the organisation of HIPEAC - European Network on High Performance and Embedded Architecture and Compilation in 2015. HIPEAC is an organisation of European researchers in the field of embedded and high-performance computers with the aim of encouraging collaboration between universities, industry, computer system designers and development tool manufacturers. This cooperation resulted in the Faculty's participation in the FP7 TETRACOM technology transfer project. The TETRACOM project connected 34 European universities and institutes with more than 50 sub-projects and 95 researchers.

The Faculty of Electrical Engineering, Computer Science and Information Technology Osijek has significant international cooperation with more than 80 reputable foreign research institutions. In the last five years, many projects have been initiated, applied for or are in the application process within the Danube Start, Erasmus Mundus Euroweb+, Erasmus+ KA 2, Interreg, COST and H2020 programs.

Currently, the Faculty cooperates with the following foreign universities: Austria (Karl-Franzens-Universitat Graz, Technische Universitat Wien), Belgium (KU Leuven), Bosnia and Herzegovina (University of Mostar; University of Tuzla; ETF Sarajevo of the University of Sarajevo) , Lithuania (Vilnius University), Hungary (Pecsi Tudomanyegyetem - University of Pecs; Budapesti Muszaki Foiskola - Budapest Tech;), Netherlands (Eindhoven University of Technology), Germany (Hochschule Albstadt-Sigmaringen, Albstadt; Hochschule Bremen - University of Applied Sciences, Fachbereich Elektrotechnik, Informatik, Bremen; Internationale Begegnungs-und Forschungszentrum für Informatik – Dagstuhl; Fachhochshule Giessen-Friedberg, University of Applied Sciences, Giessen; Universität des Saarlandes, Saarbrücken; Hochscule fur angewnadte Wissenschaften (FHWS), Wűrzburg, Schweinfurt), Poland (Technical University of Lodz; University of Technology and Life Sciences, Bydgoszcz), Portugal (Instituto Politcnico do Porto), Romania (University Stefan Cel Mare Suceava; University Politehnica of Bucharest), USA (West Virginia University, Morgantown, WV), Serbia (University of Novi Sad, Faculty of Technical Sciences; Technical College of Vocational Studies, Subotica; University of Niš), Slovakia (Slovak University of Technology, Faculty of Electrical Engineering and Information Technology, Bratislava, Slovak University of Agriculture in Nitra, University of Žilina Faculty of Management Science and Informatics), Slovenia (University of Maribor, FERI Maribor; University of Maribor, FERI Maribor, Krško; University of Ljubljana; Institut Jožef Štefan, University of Primorske, Koper), Spain (Universitat Politecnica De Cataluya (UPC-Barcelona Tech); Universitat Politecnica De Cataluya (UPC-Barcelona Tech); Escola Universitaria d'Enginyeria), Sweden (Mälardalen Hogskola, Mälardalen University, Department of Computer Science and Electronics), Turkey (Suleyman Demirel University, Isparta), Great Britain (University of Glasgow - CRADALL), India (Indian Institute of Technology Indore; Woxen University), Italy (University of L'Aquila), France (Telecom Paris Tech), Ghana (University of Mines and Technology (UMat).

With the majority of the stated European institutions, the Faculty and the University have an Erasmus+ exchange mobility agreement signed, but they cooperate in research and professional projects.

Two teachers from Bosnia and Herzegovina (University of Mostar) and two teachers from Slovenia (University of Maribor) participate in the teaching process at the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek, i.e. the Faculty teachers also participate in the teaching process at those universities.

At the end of October 2018, the Joint PhD Cooperation Agreement was signed between Josip Juraj Strossmayer University of Osijek, realised through the cooperation of FERIT and the University of Ghent in Belgium. The doctoral dissertation was supervised by Irena Galić, PhD, Full Professor (FERIT), Aleksandra Pižurica, PhD, Full Professor (University of Ghent) and Danilo Babin, PhD, Associate Professor (University of Ghent). It was done by Hrvoje Leventić, an assistant at FERIT, and defended on 5 February 2019.

In 2021, the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek signed a cooperation agreement with the European University Brčko District and the European University "Kallos" Tuzla, which defines and regulates cooperation for the purpose of developing educational, research and other forms of international cooperation in the field of higher education and science.

The Faculty has a fruitful cooperation with the Faculty of Mechanical Engineering and Computer Science in Mostar on undergraduate, graduate and especially postgraduate doctoral study programmes.

Incoming and outgoing mobility of students, teaching and non-teaching staff is important. In order to realise a mobility programme, institutions have to sign a contract. Mobility contributes to increasing the visibility, international cooperation and internationalisation of the Faculty. FERIT has signed Erasmus+ bilateral contracts with 75 partner institutions from 23 countries and multilateral cooperation agreements with 6 higher education institutions from the USA, Germany, Hungary and Serbia.

In addition to the Erasmus+ programme, students do their practical training organised by the student association IAESTE. Students and employees are also included in the CEEPUS programme.

As of 11 January 2019, the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek has been a member of the CEEPUS network CIII-HR-1302-02-1920 - Research and Education of Environmental Risks. The main coordinator of the CEEPUS network is the Faculty of Civil Engineering and Architecture Osijek, and the network gathers 19 institutions from 11 countries. The goal of the network is to train students to apply methods and current knowledge on natural hazards and risk assessment by integrating research and practical application on real building structures - special risk analysis and decision-making. Other current topics in the network are engineering design methodology, construction analysis, protection against harmful vibrations in construction, computer-supported technologies in construction mechanics, application in engineering and education, renewable energy sources, energy efficiency, application of computer programmes and techniques in the aforementioned area etc.

During 2014, the Faculty and Josip Juraj Strossmayer University of Osijek were included in the Erasmus Mundus mobility programme EUROWEB+ (European Research and Educational Collaboration with Western Balkans) with 18 other universities. Mobility between the EU and the countries of the so-called Western Balkans started in 2015. Also, the Faculty participates in several cross-border cooperation programmes, Erasmus+ projects, COST activities and other projects financed by the EU.

Systematic support during the application and implementation of mobility for students, teaching and non-teaching staff is provided by the Department for International and Interuniversity Cooperation of the University of Osijek and the Office for International Cooperation, Scientific and Professional Projects, the Erasmus coordinator and the Vice-Dean for International Cooperation at FERIT. In order to increase mobility, available funding programmes for visits to foreign institutions, teaching, research and professional training and international networking are continuously presented.

Through Erasmus+ mobility, FERIT offers foreign students with the opportunity to study at the postgraduate university study programme and take 26 courses at undergraduate and graduate study programmes in English. One of the Faculty's strategic goals was to initiate a study programme in a foreign language. It is jointly done with the Faculty of Agriculture through the project *Development and establishment of a joint study-ICT in agricultural sciences* submitted to the public call *Internationalisation of higher education*. From the academic year 2021/2022, the joint graduate university study programme in Digital Agriculture was launched in English. From the academic year 2019/2020, the graduate university study programme in Automotive Computing and Communications has been conducted in English.

Staff mobility refers to the stay of FERIT employees at a foreign host institution for the purpose of teaching, professional training (job-shadowing, i.e. monitoring the work of colleagues, conferences, seminars, workshops and courses), cooperating and participating in international projects and conferences. In the period from 1 October 2013 to 30 September 2021, 76 mobility of teaching staff and 24 mobility of non-teaching staff were realised in 53 foreign institutions in 16 countries. The purposes were teaching and/or professional training. In addition to outgoing staff mobility, incoming staff mobility, which includes the stay of foreign teaching and administrative staff at FERIT, is also extremely important. In the mentioned period, 84 foreign scientists and administrative staff from 12 countries stayed at FERIT. The increase in incoming mobility programmes in the 2018/2019 academic year is primarily a consequence of the cooperation and mobility of consortium members within the Erasmus+ E-ProfEng project. In the period from 1 October 2013 to 30 September 2021, a total of 107 FERIT students stayed abroad for the purpose of studying and professional training, while a total of 78 students stayed at FERIT in the same period. All outgoing and incoming teaching/non-teaching staff mobility programmes lasted up to three months, while all student Erasmus+ mobility programmes lasted more than three months.

3.25. If the study programme is in the fields of regulated professions, elaborate on how you determined compliance with the minimum training requirements prescribed by Directive 2005/36/EC of the European Parliament and the Council on the recognition of professional qualifications of 7 September 2005 and the Act on Regulated Professions and the Recognition of Foreign professional qualifications.

The study programme is not in the fields of regulated professions.

4. DESCRIPTION OF THE STUDY PROGRAMME

4.1. Attach a list of obligatory and elective courses with corresponding workload and ECTS credits

See Appendix 7.4.

4.1.1. Attach a description of each course

See Appendix 7.5.

4.1.2. General data on the course

See Appendix 7.5.

4.1.3. Course description

See Appendix 7.5.

4.2. Describe the study structure, pace and requirements for enrolment in the following semester or trimester as well as the requirements for each course or a group of courses.

The current undergraduate university study programme in Electrical Engineering and Information Technology serves as the foundation for the amended study programme. The semester-based undergraduate university study programme in Electrical Engineering and Information Technology consists of six semesters, i.e., three years of study. So far, students have been able to choose from two elective modules in their second year of study: Power Engineering and Communications and Informatics. Instead of elective modules, the proposed amendments to the undergraduate university study programme in Electrical Engineering and Information Technology will offer two branches: Electrical Engineering and Information and Communication Technology.

When enrolling in the study programme, students will be able to opt for the following two branches:

- ET – Electrical Engineering
- IKT – Information and Communication Technology

Based on the elected branch, a student enrols in courses specific to that branch as detailed below. Nonetheless, depending on the intended competencies, some courses can be taught in both branches.

In the amended study programme, some compulsory courses are represented in both branches:

- In Semester 1, out of seven compulsory courses in the proposed study programme, all seven are taught in both branches.
- In Semester 2, out of six compulsory courses in the proposed study programme, four are taught in both branches.
- In Semester 3, out of six compulsory courses in the proposed study programme, two are taught in both branches.
- In Semester 4, out of seven compulsory courses in the proposed study programme, five are taught in both branches.
- In Semester 5, out of six compulsory courses in the proposed study programme, one is taught in both branches.
- In Semester 6, out of five compulsory courses in the proposed study programme, three are taught in both branches.

The study programme structure with a list of courses per semester and branches is as follows.

Semester 1:

Branch: ELECTRICAL ENGINEERING	**Branch: INFORMATION AND COMMUNICATION TECHNOLOGY**
Linear Algebra	Linear Algebra
Calculus I	Calculus I
Fundamentals of Electrical Engineering I	Fundamentals of Electrical Engineering I
Engineering Graphics and Documentation	Engineering Graphics and Documentation
Programming I	Programming I
Physical Education I	Physical Education I
Communication Skills	Communication Skills

Semester 2:

Branch: ELECTRICAL ENGINEERING	**Branch: INFORMATION AND COMMUNICATION TECHNOLOGY**
Calculus II	Calculus II
Programming II	Programming II
Physical Education II	Physical Education II
Basics of Electronics	Basics of Electronics
Fundamentals of Electrical Engineering II - ET	Fundamentals of Electrical Engineering II - IKT
Introduction to Mechanics and Electromagnetism	Engineering Mechanics

Semester 3:

Branch: ELECTRICAL ENGINEERING	**Branch: INFORMATION AND COMMUNICATION TECHNOLOGY**
Calculus III	Calculus III
Physical Education III	Physical Education III
Basics of Metrology	Basics of Electrical Signals Measurement
Theory of Electrical Networks	Operating Systems
Energy Conversions	Analogue Electronics
Electrical Engineering Materials	Algorithms and Data Structures

Semester 4:

Branch: ELECTRICAL ENGINEERING	**Branch: INFORMATION AND COMMUNICATION TECHNOLOGY**
Communication Networks	Communication Networks
Probability and Statistics	Probability and Statistics
Signals and Systems	Signals and Systems
Technical English I	Technical English I
Physical Education IV	Physical Education IV
Fundamentals of Electric Machines and Drives	Digital and Pulse Circuits
Basics of Energy and Ecology	Information Theory

Semester 5:

Branch: ELECTRICAL ENGINEERING	**Branch: INFORMATION AND COMMUNICATION TECHNOLOGY**
Technical English II	Technical English II
Basics of Power Systems	Fundamentals of Object-Oriented Programming
Basics of Automatic Control	Basics of Microcontroller Systems
Principles of Power Electronics	Fundamentals of Power Engineering
Electrical Installations and Lighting	Electromagnetic Fields and Waves
Electrical Machines and Drives Analysis	Databases

In semester 6, students prepare their Final Papers which leads to the completion of their studies.

Semester 6:

Branch: ELECTRICAL ENGINEERING	**Branch: INFORMATION AND COMMUNICATION TECHNOLOGY**
Technical English III	Technical English III
Business Economics	Business Economics
Final Paper	Final Paper
Power System Analysis	Introduction to Machine Learning
Information and Communication Technologies in the Power Industry	Communication Systems

Note:

- In semesters 1, 2 and 3, students can take an optional course.

4.2.1 Beginning and end of classes

The beginning and end of each academic year are defined by the University Senate's Decision on the Academic Calendar, which is an integral part of the curriculum.

4.2.2. Requirements for enrolment in the successive academic year

The enrolment requirements in the successive academic year are determined by the Ordinance on Studies and Studying of J.J. Strossmayer University of Osijek as well as the University Senate's Decision on Requirements for Enrolment in the Successive Year, and they refer to the following:

- regular fulfilment of obligations determined in the study programme
- the number of ECTS credits earned by passing the exams.

4.2.3 General and specific terms and conditions of studying

Students of the undergraduate study programme in Electrical Engineering and Information Technology are subject to general and specific terms and conditions of studying defined by the Statute and Ordinance on Studying and Studies of J.J. Strossmayer University of Osijek and they refer to the following:

- acquiring student status (full-time students, guest students, special student status: categorised athletes and top artists, exceptionally successful students)
- transferring from other related university study programmes
- resuming interrupted studies
- mobility within the University
- students' right and obligations (e.g., right to a leave of absence)
- student workload (ECTS)
- advancement during the study (enrolment in the successive year, cancelling the enrolled course, repeating a year of study, semester validation and teacher's signature, examinations and other types of assessment, grade complaints, recognition of exams passed at other universities)
- termination of student status.

4.2.4 Student status

The undergraduate university study programme in Electrical Engineering and Information Technology can be enrolled as a full-time study.

4.3. Attach a list of courses students can enrol in other study programmes.

When enrolling in the undergraduate university study programme in Electrical Engineering and Information Technology, students will be able to opt for the following two branches: Electrical Engineering and Information and Communication Technology.
Also, students can choose elective courses offered at other University constituent units.

4.4. Attach a list of courses which can be taught in a foreign language.

Algorithms and Data Structures, English
Power System Analysis, English
Analogue Electronics, English
Databases, English
Digital and Pulse Circuits, English
Electrical Installations and Lighting, English
Electromagnetic Fields and Waves, English
Energy Conversions, English
Information and Communication Technologies in the Power Industry, English
Engineering Mechanics, English
Communication Networks, English
Communication Systems, English
Operating Systems, English
Basics of Power Systems, English
Basics of Energy and Ecology, English
Basics of Microcontroller Systems, English
Introduction to Machine Learning, English
Programming I, English
Programming II, English
Signals and Systems, English
Information Theory, English
Introduction to Mechanics and Electromagnetism, English

4.5. Describe the process of completing the study programme.

The undergraduate university study programme in Electrical Engineering and Information Technology is completed by passing all exams, writing and defending a Master's thesis.
With the thesis, a student must demonstrate the ability to apply the knowledge gained during the studies and show that they can successfully solve tasks relevant to their profession and suitable to the academic degree they have been awarded.
Details related to writing the Master's thesis are regulated by the Faculty's Regulations on Final Papers and Master's Thesis.

4.6. Write the conditions under which students who have interrupted their studies or lost the right to study in a specific study programme can continue their studies.

The conditions under which students who have interrupted their studies or lost the right to study in a specific study programme can continue their studies are defined by the Statute, i.e., the Ordinance on Studies and Studying at the J.J. Strossmayer University of Osijek. The conditions for resuming interrupted

studies are stipulated by Article 37, and the conditions for completing their studies are stipulated by Article 38 of the Ordinance on Studies and Studying at the Josip Juraj Strossmayer University in Osijek.

Continuation of interrupted studies (Article 37)

(1) A student who had a full-time status and then lost it due to interrupting their studies may continue their education as a part-time student, provided that the study programme has not been significantly altered (more than 20%) from the one in which the student was enrolled.
(2) The applicant can submit a request to continue their studies if no more than three years have passed since the last academic year of study they were enrolled in and the submission of the request to continue their studies.
(3) A request for approval to continue interrupted studies is submitted to the professional council or the authorised body of the professional council on a specially prescribed form by the study programme provider, along with the index (record book) and appropriate documentation as prescribed by the study programme provider, before the enrolment deadline expires.
(4) Studies are continued based on the Decision on the Continuation of Interrupted Studies issued by the professional council or the authorised body of the professional council in accordance with the study programme. The decision takes into account recognised exams with grades and earned ECTS credits during the study period, as well as differential and additional exams in accordance with the study programme of the study programme provider where the student continues their education.

Completion of studies (Article 38)

(1) A person who has lost their full-time status must be allowed to complete their studies in such a way that deadlines are set from the first year of enrolment in the study programme as follows:
- for a short professional study programme within five (5) years,
- for an undergraduate university study programme and an undergraduate professional study programme within six (6) years,
- for a graduate university study programme and a specialist graduate professional study programme within four (4) years, and
- for an integrated undergraduate and a graduate university study programme within ten (10) years, in accordance with the study programme of the authorised scientific-teaching/artistic-teaching and teaching constituents for the organisation and implementation of studies.

(2) Individuals completing their studies as outlined in paragraph 1 of Article 38 are not eligible for student rights and are required to pay either the full amount or a portion of the tuition fee, as specified by the Senate Decision.
(3) A person completing their studies is required to submit a request to the professional council or the authorised body of the professional council on a specially prescribed form by the study programme provider, along with the index (record book) and appropriate documentation as prescribed by the study programme provider.
(4) The decision to approve the completion of studies is made by the professional council or the authorised body of the professional council.
(5) The decision made by the professional council or its authorised body shall encompass recognised exams, including grades and accumulated ECTS credits earned during the study period. Additionally, it shall cover differential and additional exams as required by the study programme of the institution where the study completion was authorised. The decision shall also specify the deadlines for completing the studies and for the payment of either a portion of or the entire tuition fee, as determined by the Senate Decision.

5. APPENDICES

5.1. Decision of the Faculty Council on the amendments to the study programme

SVEUČILIŠTE JOSIPA JURJA STROSSMAYERA U OSIJEKU
FAKULTET ELEKTROTEHNIKE, RAČUNARSTVA I INFORMACIJSKIH TEHNOLOGIJA OSIJEK
JOSIP JURAJ STROSSMAYER UNIVERSITY OF OSIJEK
FACULTY OF ELECTRICAL ENGINEERING, COMPUTER SCIENCE AND INFORMATION TECHNOLOGY OSIJEK
FERIT

KLASA: 602-01/22-08/01
URBROJ: 2158-80-09-22-08
Osijek, 08. veljače 2022.

Na temelju članka 47. stavak 1. podstavka 13. Statuta Fakulteta elektrotehnike, računarstva i informacijskih tehnologija Osijek – pročišćeni tekst, Fakultetsko vijeće Fakulteta elektrotehnike, računarstva i informacijskih tehnologija Osijek, na 270. sjednici (7. sjednici Fakultetskog vijeća u akademskoj 2021./2022. godini) održanoj 08. veljače 2022. godine, pod točkom 5. dnevnog reda, donijelo je sljedeću

O D L U K U

1. Prihvaća se prijedlog izmjena i dopuna preko 20% studijskog programa **preddiplomskog sveučilišnog studija Elektrotehnika i informacijska tehnologija na Fakultetu elektrotehnike, računarstva i informacijskih tehnologija Osijek, Sveučilišta Josipa Jurja Strossmayera u Osijeku**
2. Izmjene i dopune studijskog programa preddiplomskog sveučilišnog studija Elektrotehnika i informacijska tehnologija dostavljaju se Povjerenstvu za preddiplomske, diplomske i stručne studije Sveučilišta Josipa Jurja Strossmayera u Osijeku na daljnji postupak.
3. Ova Odluka stupa na snagu danom donošenja.

Dekan
Prof. dr. sc. Tomislav Matić

Dostaviti:
1. Povjerenstvo za preddiplomske, diplomske i stručne studije Sveučilišta Josipa Jurja Strossmayera u Osijeku
2. Pismohrana Fakultetskog vijeća
3. Pismohrana Fakulteta

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Hrvatska poštanska banka: IBAN HR19 2390 0011 1000 1677 7 | Addiko Bank: IBAN HR6025000091013 7287 0

5.2. A list of compulsory and elective courses with the number of contact hours required for their implementation and the number of ECTS credits.

Table 1

LIST OF BRANCHES/COURSES							
Year of Study: 1							
Semester: 1							
Branch	COURSE	LEAD INSTRUCTOR(S)	L	E	S	ECTS	STATUS[1]
Electrical Engineering	Linear Algebra	Anita Katić, PhD, Assistant Professor	30	30	0	5	O
	Calculus I	T. Rudec, PhD, Assistant Professor	30	30	0	5	O
	Fundamentals of Electrical Engineering I	Ž. Hederić, PhD, Full Professor M. Barukčić, PhD, Associate Professor	45	45	0	7	O
	Engineering Graphics and Documentation	G. Rozing, PhD, Assistant Professor	30	15	0	4	O
	Programming I	Goran Martinović, PhD, Full Professor A. Baumgartner, PhD, Associate Professor	30	30	0	5	O
	Physical Education I	P. Kerže, MKin, Senior Lecturer	0	30	0	1	O
	Communication Skills	J. Glavaš*, PhD, Associate Professor	30	15	0	3	O
Information and Communication Technology	Linear Algebra	Anita Katić, PhD, Assistant Professor	30	30	0	5	O
	Calculus I	T. Rudec, PhD, Assistant Professor	30	30	0	5	O
	Fundamentals of Electrical Engineering I	Ž. Hederić, PhD, Full Professor M. Barukčić, PhD, Associate Professor	45	45	0	7	O
	Engineering Graphics and Documentation	G. Rozing, PhD, Assistant Professor	30	15	0	4	O
	Programming I	Goran Martinović, PhD, Full Professor	30	30	0	5	O

[1]**IMPORTANT:** If a course is compulsory, 0 is entered, and if it is an elective, I is entered.

		A. Baumgartner, PhD, Associate Professor					
	Physical Education I	P. Kerže, MKin, Senior Lecturer	0	30	0	1	O
	Communication Skills	J. Glavaš*, PhD, Associate Professor	30	15	0	3	O

LIST OF BRANCHES/COURSES							
Year of Study: 1							
Semester: 2							
Branch	COURSE	LEAD INSTRUCTOR(S)	L	E	S	ECTS	STATUS[2]
Electrical Engineering	**Calculus II**	Anita Katić, PhD, Assistant Professor	30	30	0	4	O
	Programming II	J. Job, PhD, Associate Professor	30	45	0	5	O
	Physical Education II	P. Kerže, MKin, Senior Lecturer	0	30	0	1	O
	Basics of Electronics	T. Matić (Sr.), PhD, Full Professor D. Vinko, PhD, Associate Professor	45	45	0	6	O
	Fundamentals of Electrical Engineering II - ET	Ž. Hederić, PhD, Full Professor M. Barukčić, PhD, Associate Professor	45	45	0	6	O
	Introduction to Mechanics and Electromagnetism	M. Skender, PhD, Assistant Professor	50	40	0	8	O
Information and Communication Technology	**Calculus II**	Anita Katić, PhD, Assistant Professor	30	30	0	4	O
	Programming II	J. Job, PhD, Associate Professor	30	45	0	5	O
	Physical Education II	P. Kerže, MKin, Senior Lecturer	0	30	0	1	O
	Basics of Electronics	T. Matić (Sr.), PhD, Full Professor D. Vinko, PhD, Associate Professor	45	45	0	6	O
	Fundamentals of Electrical Engineering II - IKT	Ž. Hederić, PhD, Full Professor M. Barukčić, PhD, Associate Professor	45	45	0	6	O
	Engineering Mechanics	M. Skender, PhD, Assistant Professor	50	40	0	8	O

[2]**IMPORTANT:** If a course is compulsory, 0 is entered, and if it is an elective, I is entered.

LIST OF BRANCHES/COURSES							
Year of Study: 2							
Semester: 3							
Branch	COURSE	LEAD INSTRUCTOR(S)	L	E	S	ECTS	STATUS[3]
Electrical Engineering	**Calculus III**	T. Marošević*, PhD, Associate Professor	45	30	0	5	O
	Physical Education III	P. Kerže, MKin, Senior Lecturer	0	30	0	1	O
	Basics of Metrology	K. Miličević, PhD, Full Professor	45	45	0	7	O
	Theory of Electrical Networks	K. Miličević, PhD, Full Professor D. Pelin, PhD, Full Professor	45	30	0	6	O
	Energy Conversions	M. Stojkov*, PhD, Full Professor M. Skender, PhD, Assistant Professor	45	30	0	6	O
	Electrical Engineering Materials	G. Rozing, PhD, Assistant Professor	30	30	0	5	O
Information and Communication Technology	**Calculus III**	T. Marošević*, PhD, Associate Professor	45	30	0	5	O
	Physical Education III	P. Kerže, MKin, Senior Lecturer	0	30	0	1	O
	Basics of Electrical Signals Measurement	K. Miličević, PhD, Full Professor V. Mandrić, PhD, Associate Professor	45	45	0	6	O
	Operating Systems	G. Martinović, PhD, Full Professor	45	30	0	6	O
	Analogue Electronics	T. Matić (Sr.), PhD, Full Professor M. Herceg, PhD, Associate Professor	45	30	0	6	O
	Algorithms and Data Structures	A. Baumgartner, PhD, Associate Professor	45	30	0	6	O

[3]**IMPORTANT:** If a course is compulsory, 0 is entered, and if it is an elective, I is entered.

LIST OF BRANCHES/COURSES							
Year of Study: 2							
Semester: 4							
Branch	COURSE	LEAD INSTRUCTOR(S)	L	E	S	ECTS	STATUS[4]
Electrical Engineering	**Communication Networks**	D. Žagar, PhD, Full Professor K. Grgić, PhD, Associate Professor	45	30	0	6	O
	Probability and Statistics	R. Galić*, PhD, Full Professor T. Rudec, PhD, Assistant Professor	30	30	0	5	O
	Signals and Systems	Irena Galić, PhD, Associate Professor	30	30	0	5	O
	Technical English I	I. Ferčec, MA, Senior Lecturer Y. Liermann-Zeljak, MA, Senior Lecturer	15	15	0	2	O
	Physical Education IV	P. Kerže, MKin, Senior Lecturer	0	30	0	1	O
	Fundamentals of Electric Machines and Drives	T. Barić, PhD, Full Professor	45	30	0	5,5	O
	Basics of Energy and Ecology	D. Šljivac, PhD, Full Professor	45	30	0	5,5	O
Information and Communication Technology	**Communication Networks**	D. Žagar, PhD, Full Professor K. Grgić, PhD, Associate Professor	45	30	0	6	O
	Probability and Statistics	R. Galić*, PhD, Full Professor T. Rudec, PhD, Assistant Professor	30	30	0	5	O
	Signals and Systems	Irena Galić, PhD, Associate Professor	30	30	0	5	O
	Technical English I	I. Ferčec, MA, Senior Lecturer Y. Liermann-Zeljak, MA, Senior Lecturer	15	15	0	2	O
	Physical Education IV	P. Kerže, MKin, Senior Lecturer	0	30	0	1	O
	Digital and Pulse Circuits	D. Vinko, PhD, Associate Professor T. Matić (Sr.), PhD, Full Professor	30	30	0	5	O

[4]**IMPORTANT:** If a course is compulsory, 0 is entered, and if it is an elective, I is entered.

	Information Theory	D. Žagar, PhD, Full Professor V. Križanović, PhD, Assistant Professor	45	30	0	6	O

LIST OF BRANCHES/COURSES							
Year of Study: 3							
Semester: 5							
Branch	COURSE	LEAD INSTRUCTOR(S)	L	E	S	ECTS	STATUS[5]
Electrical Engineering	**Technical English II**	I. Ferčec, MA, Senior Lecturer, Y. Liermann-Zeljak, MA, Senior Lecturer	30	15	0	2	O
	Basics of Power Systems	K. Fekete, PhD, Associate Professor	45	30	0	6	O
	Basics of Automatic Control	D. Slišković, PhD, Full Professor	45	30	0	6	O
	Principles of Power Electronics	D. Pelin, PhD, Full Professor	45	30	0	6	O
	Electrical Installations and Lighting	Z. Klaić, PhD, Associate Professor	30	15	0	4	O
	Electrical Machines and Drives Analysis	Ž. Hederić, PhD, Full Professor	45	30	0	6	O
Information and Communication Technology	**Technical English II**	I. Ferčec, MA, Senior Lecturer, Y. Liermann-Zeljak, MA, Senior Lecturer	30	15	0	2	O
	Fundamentals of Object-Oriented Programming	D. Bajer, PhD, Assistant Professor B. Zorić, PhD, Assistant Professor	30	30	0	5	O
	Basics of Microcontroller Systems	D. Vinko, PhD, Associate Professor	15	45	0	5	O
	Fundamentals of Power Engineering	H. Glavaš, PhD, Associate Professor	30	15	0	5	O
	Electromagnetic Fields and Waves	S. Rupčić, PhD, Full Professor M. Skender, PhD, Assistant Professor	45	30	0	7	O
	Databases	I. Lukić, PhD, Associate Professor	45	30	0	6	O

[5]**IMPORTANT:** If a course is compulsory, 0 is entered, and if it is an elective, I is entered.

LIST OF BRANCHES/COURSES							
Year of Study: 3							
Semester: 6							
Branch	COURSE	LEAD INSTRUCTOR(S)	L	E	S	ECTS	STATUS[6]
Electrical Engineering	**Technical English III**	I. Ferčec, MA, Senior Lecturer Y. Liermann-Zeljak, MA, Senior Lecturer	15	15	0	2	O
	Business Economics	D. Crnjac Milić, PhD, Full Professor	30	15	0	3	O
	Final Paper		0	0	0	12	O
	Power System Analysis	K. Fekete, PhD, Associate Professor	45	30	0	7	O
	Information and Communication Technologies in the Power Industry	D. Vranješ, PhD, Assistant Professor	45	30	0	6	O
Information and Communication Technology	**Technical English III**	I. Ferčec, MA, Senior Lecturer Y. Liermann-Zeljak, MA, Senior Lecturer	15	15	0	2	O
	Business Economics	D. Crnjac Milić, PhD, Full Professor	30	15	0	3	O
	Final Paper		0	0	0	12	O
	Introduction to Machine Learning	R. Grbić, PhD, Associate Professor M. Vranješ, PhD, Associate Professor	45	30	0	7	O
	Communication Systems	S. Rimac-Drlje, PhD, Full Professor	45	30	0	6	O

* external associates

[6]**IMPORTANT:** If a course is compulsory, 0 is entered, and if it is an elective, I is entered.

5.3. Description and general information about each course

General information		
Lead instructor(s)	Anita Katić, PhD, Assistant Professor	
Course title	Linear Algebra	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	30+(30+0+0)+0

1. COURSE DESCRIPTION

1.1. Course objectives

Introduce students to the basic concepts and methods of linear algebra and establish a solid foundation of fundamental knowledge about vectors, matrices, and vector spaces, which are essential for the further course of study. Through a series of examples and exercises, equip students with the skills for mathematical expression, abstract thinking, and problem-solving using the concepts and methods of linear algebra.

1.2. Course enrolment requirements

Requirements for enrolment in the study programme fulfilled.

1.3. Expected learning outcomes

1. Explain and define the concept of vectors in the plane and in space.
2. Apply vector operations in solving problems.
3. For a given relationship of points, lines, and planes in space, create equations whose solutions will yield the desired object or relationship, utilizing the acquired knowledge of vectors.
4. Recognize different types of matrices and perform arithmetic operations with matrices.
5. Describe the necessary and sufficient conditions for the solvability of systems of linear equations.
6. Solve systems of linear equations using different methods and discuss the solutions.
7. Determine the basis and dimension of a finite-dimensional vector space.
8. Examine the linearity of a given operator, determine the matrix representation of the linear operator, and create its kernel and image.
9. Determine the minimal polynomial, characteristic polynomial, eigenvalues, and eigenvectors of a linear operator, and recognize whether it can be associated with a diagonal matrix.

1.4. Course content

Vector space V3. Vector operations. Linear dependence of vectors from V3. Vector projection. Basis of the vector space V3. Coordinate system. Scalar, vector, and mixed products.
Analytic geometry of space. Point, line, plane, and their mutual relationships. The concept of a matrix and elementary matrix transformations. Matrix operations. Vector space of matrices. The concept of a determinant and its properties. Calculating the value of a determinant. Rank of a matrix. Regular matrices.
System of linear algebraic equations. Existence and uniqueness of system solutions. Methods for solving systems of linear equations – Gaussian elimination method and Cramer's rule.
Finite – dimensional vector spaces and subspaces – definitions and examples. Basis and dimension of a vector space. The concept of a linear operator. Kernel and image of a linear operator. Matrix representation of a linear

operator and transition matrices. Matrix similarity. Minimal polynomial. Eigenvalues and eigenvectors. Characteristic polynomial. Cayley – Hamilton theorem. Matrix diagonalization.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☐ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE),	1.5	1-9	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Homework assignments	1	2, 3, 4, 6, 8, 9	Preparation for written knowledge assessment	Evaluation of solutions for a given problem	0	10
Problem-solving exercises	1	2, 3, 4, 6, 8, 9	Revision exams (written exam)	Evaluation	20	40
Preparing for an oral exam and oral exam	1.5	1-9	Oral exam	Evaluation	25	50

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. N. Elezović, A. Aglić, Linearna algebra, zbirka zadataka, Element, Zagreb, 2001
2. N. Elezović, Linearna algebra, Element, Zagreb, 1995
3. K. Horvatić, Linearna algebra, PMF Matematički odjel, Zagreb, 1995

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. S. Kurepa, Uvod u linearnu algebru, Školska knjiga, Zagreb, 1990
2. L. Čaklović, Zbirka zadataka iz linearne algebre, Školska knjiga, Zagreb, 1979
3. Lipschutz, Seymour, Linear algebra, Schaum's outlines, 1991
4. R. Galić, Osnive linearne algebre, ETF, Osijek, 1994
5. N. Bakić, A. Milas, Zbirka zadataka iz linearne algebre, PMF Matematički odjel, Zagreb, 1995

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*

N. Elezović, A. Aglić, Linearna algebra, zbirka zadataka, Element, Zagreb, 2001	28	140
N. Elezović, Linearna algebra, Element, Zagreb, 1995	28	140
K.Horvatić, Linearna algebra, PMF Matematički odjel, Zagreb, 1995	28	140

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Rudec Tomislav, PhD, Assistant Professor	
Course title	Calculus I	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	30+30+0+0+0

1. COURSE DESCRIPTION

1.1. Course objectives

1.2. Course enrolment requirements

There are no special requirements for enrolling in the course.

1.3. Expected learning outcomes

1. discuss the properties of the given elementary function by knowing the properties and characteristic examples of elementary
functions
2. construct a model for the decision on the convergence of the given sequence by knowing the properties and the characteristic
examples of sequenceS
3. discuss the general characteristics of different elementary functions by comparing them
4. construct the form of a default function
5. construct a mathematical or physical problem model using differential calculus

1.4. Course content

1. Preliminaries. Real numbers, infimum and supremum, absolute value, intervals. Complex numbers. 2. Functions. Definition of a function. Basic properties. Composition of functions. Inverse function. Elementary functions (polynomial, rational, exponential, logarithm, trigonometric, cyclometric, hyperbolic and area functions). 3. Sequences of real numbers. Concept of a sequence, properties and convergence. Number e. 11 4. Limits and continuity of functions. Concept and properties of the limits of the function. Asymptotes. Continuity of functions. 5. Differential calculus. The derivative and the tangent. The derivative as velocity.

Concept of the derivative. Derivative rules. The chain rule and the derivative of the inverse function. The derivative of elementary functions. Implicit differentiation. Parametric differentiation. Mean value theorem. Higher derivatives. Taylor's theorem. 6. Application of the differential calculus. Differential. Newton's method. L'Hôpital's rule. Examination of functions (monotonicity, minima and maxima, convexity, asymptotes). Sketching curves.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☐ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☐ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance Lectures, Auditory exercises	1.2	1,2,3,4	Lectures (L), Auditory exercises (AL)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Practice – problem solving	1.1	1,3,4,5	Midterm exam	Evaluation of (written) exercises	20	40
Oral exam	1.7	1,2,3,4	Oral exam	Assessment of student's answers	25	50
Revision exams	1	1,2,4,5	Revision exams	Checking solutions	0	10

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Galić, A; D.Crnjac Milić; Galić, I;.Katić, A. Matematika 1.Osijek: ETF Osijek, 2008.
2. Demidović, B.P. - Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke. Zagreb:Tehnička knjiga, 2003.
3. S. Kurepa, Matematička analiza 1 (diferenciranje i integriranje), Tehnička knjiga, Zagreb, 1989.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. S. Kurepa, Matematička analiza 2 (funkcije jedne varijable), Tehnička knjiga, Zagreb, 1990.

2. W. Rudin, Principles of Mathematical Analysis, Mc Graw-Hill, Book Company, 1964.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Željko Hederić, PhD, Full Professor, Marinko Barukčić, PhD, Associate Professor	
Course title	Fundamentals of Electrical Engineering I	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	7
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(45+(30+15+0)+0)

1. COURSE DESCRIPTION

1.1. Course objectives

Provide students with the competencies needed for modeling and analyzing electrical networks in steady states with the presence of sources with time-invariant and mono-harmonic currents and voltages.

1.2. Course enrolment requirements

Requirements for enrolment in the study programme fulfilled.

1.3. Expected learning outcomes

1. Present basic electrical quantities and concepts in DC (direct current) and AC (alternating current) circuits.
2. Assess the suitability and apply appropriate mathematical models of basic components in real DC and AC circuits.
3. Apply phasor transformation rules to connect electrical quantities in the time domain with quantities in the phasor domain.
4. Evaluate methods for solving DC and AC electrical circuits with linear elements in steady state.
5. Evaluate solutions obtained using network theorems.
6. Measure electrical quantities in elements of DC circuits and AC circuits.
7. Critically analyze solutions of mathematical models of multiphase AC electrical networks with linear elements in steady state, focusing on power flow analysis in the network.

1.4. Course content

- Concept of electric current and voltage
- Concept and types of waveforms of electric currents and voltages
- Concept of electric circuit
- Mathematical modeling of elements of electric circuits, concept of active and passive components

• Current-voltage characteristics of passive and active components, parameters of passive components, Ohm's law, Joule's law
• Concept and concept of equivalent circuit of electric circuit, Kirchhoff's laws, parallel, series, delta and star connections of components (resistance, inductance, capacitance)
• Methods (mesh currents, node potentials) and theorems (Thevenin's, Norton's, Millman's, reciprocity, superposition) for analysis of electric circuits, application of methods and theorems for analysis of time-invariant currents and voltages
• Waveforms of sinusoidal currents and voltages, complex waveforms of currents and voltages, average and effective values of currents and voltages
• Steady-state conditions of sinusoidal currents and voltages, concept of phasor (phasor diagram), reactance, impedance and admittance, connections of impedances and admittances
• Application of methods and theorems for analysis of circuits with sinusoidal currents and voltages
• Electric power in electric circuits and maximum power theorem (time-invariant and sinusoidal currents and voltages), stored energy in capacitors and inductors, reactive power compensation
• Three-phase electric circuits (symmetrical and asymmetrical, analysis, electric power, phasor diagram)
• Magnetically coupled inductors (concept of mutual inductance, connections, analysis of circuits with magnetic couplings, energy)
• Application of superposition method for analysis of circuits with multi-harmonic currents and voltages (concept of higher harmonics, average and effective values, electric power)
• Introduction to simulations of direct current and sinusoidal electric circuits using computer tools

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☒ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	2.5	1, 2, 3, 4, 5, 7	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	1.0	1, 3, 5, 7	Revision exams (written exam)	Evaluation	20	40

Preparation for laboratory exercises (LE), results analysis, report writing	1.0	6	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	5	10
Individual work	1.0	2, 4, 7			5	10
Preparing for an oral exam and oral exam	1.5	1, 3, 4, 5, 7	Oral exam	Evaluation	20	40

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Kuzmanović, B. Osnove elektrotehnike I i II
2. Šehović, Felja, Tkalić Osnove elektrotehnike zbirka primjera prvi dio
3. Felja, Koračin, Zbirka zadataka i riješenih primjera iz Osnova elektrotehnike, I. i II. dio
4. Hederić, Željko; Snježana Rimac-Drlje; Barukčić, Marinko Osnove elektrotehnike I. Priručnik za laboratorijske vježbe
5. Hederić, Željko; Barukčić, Marinko Osnove elektrotehnike II. Priručnik za laboratorijske vježbe

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. V. Pinter Osnove elektrotehnike I i II
2. B. Kuzmanović Zbirka zadataka i pitanja iz Osnova elektrotehnike 1 i 2
3. Alexander, Charles K; Sadiku, Matthew N.O. Fundamentals of Electric Circuits
4. J. Edminister Electric Circuits

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Kuzmanović, B. Osnove elektrotehnike I i II	40	120
Šehović, Felja, Tkalić Osnove elektrotehnike zbirka primjera prvi dio	20	120
Felja, Koračin, Zbirka zadataka i riješenih primjera iz Osnova elektrotehnike, I. i II. dio	20	120

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Goran Rozing, PhD, Assistant Professor	
Course title	Engineering Graphics and Documentation	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	4
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	30+(0+0+15)+0

1. COURSE DESCRIPTION

1.1. Course objectives

Training students for the design and presentation of technical documentation in the field of electrical engineering and information technology, using modern CAD software 2D and 3D tools.

1.2. Course enrolment requirements

Requirements for enrolment in the study programme fulfilled.

1.3. Expected learning outcomes

1. Define the basic concepts of graphic communication in technology
2. Create projections of simple geometric relationships of point, length, direction, figure and body
3. Create a technical drawing and draw orthogonal projections, isometry and section
4. Apply CAD tools in the creation of a project of technical documentation in the field of electrical engineering and information technology
5. Define and apply the basic methods of 3D CAD modeling with the connection of additive manufacturing (3D printing of simple objects from the field of electrical engineering and information technology)

1.4. Course content

Basics of technical drawing and geometric construction. Graphic communication in technical applications. Orthogonal and axonometric projections, body sections, types of lines, dimensioning, and standards and rules for creating technical documentation. Graphical interpretation in space and plane. Isometry. Meaning and possibilities of graphic communication in electrical engineering. Symbols of basic electrotechnical, electronic and electromechanical elements and assemblies. Types, creation and use of schemes in the electrical engineering profession. Block diagram. Action diagrams, circuit diagrams, connection diagrams, connection plan. Logic circuit diagrams and drawing methods. Connection schemes. Text documentation. Technical description, instructions for use. Description of components and methods of use of the CAD system. Use of CAE system for managing electrical projects and additional documentation. Introduction to documenting electronic devices (assemblies, plants) using CAD software. Basics of construction and creation of documentation using computers. Work on the AutoCAD program. Marking of elements according to IEC regulations. Basic 3D CAD modeling: sketch-based modeling, modeling operations, feature-based modeling, creating 2D drawings from simple 3D parts, links to additive manufacturing (3D printing).

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☐ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☐ laboratory exercises ☒ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	

					Min	Max
Attendance at Lectures (L), Design exercises (DE)	1.5	1,2,3,4,5	Lectures (L), Design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	2	5
Preparation for the oral exam and answering questions orally	0.5	1,2,3,4,5	Oral exam	Evaluation	18	35
Solving the problem set on (CE)	0.9	1,2,3,4,5	Design exercises (DE)	Evaluation	12	20
Visual drawings	0.4	3	Visual drawings	Direct observation	0	10
Homework	0.4	4	Visual drawings	Direct observation	0	20
Preparing for an oral exam and oral exam	0.3	3,5	Written exam	Checking drawings	0	10

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. M. Kljajin, M. Opalić: Inženjerska grafika, Strojarski fakultet u Slavonskom Brodu, Slavonski Brod, 2016.
2. Padovan, Lukša: Inženjerska grafika i dokumentiranje, Graphis d.o.o. Zagreb, Zagreb, 2004.
3. M. Opalić, M. Kljajin, S. Sebastijanović: Tehničko crtanje, Zrinski d.d., Čakovec 2003.
4. Omura, George Mastering AutoCAD 2016 and AutoCAD LT 2016.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. David E. Goetsch, Raymond L. Rickman: Technical drawing for engineering communication 7 th Edition, 2016.
2. Elise Moss: Autodesk AutoCAD 2022 Fundamentals, SDC Publications, 2021.
3. Bernd Gischel, EPLAN Electric P8 Reference Handbook, Carl Hanser Verlag GmbH Co KG. 2015.
4. J. H. Earle: Graphics for Engineers Addison-Wesley Publishing Company, New York, 1999.
5. F. E. Giesecke, A. Mitchell, H.C. Spencer, I.L. Hill, J.T. Dygton: Technical Drawing Machimillan Publishing Company, New York, 1986.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
M. Kljajin, M. Opalić: Inženjerska grafika, Strojarski fakultet u Slavonskom Brodu, Slavonski Brod, 2016.	10	140
Padovan, Lukša: Inženjerska grafika i dokumentiranje, Graphis d.o.o. Zagreb, Zagreb, 2004.	10	140
M. Opalić, M. Kljajin, S. Sebastijanović: Tehničko crtanje, Zrinski d.d., Čakovec 2003.	10	140
Omura, George Mastering AutoCAD 2016 and AutoCAD LT 2016.	10	140

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Goran Martinović, PhD, Full Professor, Alfonzo Baumgartner, PhD, Associate Professor	
Course title	Programming I	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	30+(15+15+0)+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
The goal of the course is to explain to students the basics of algorithmic thinking in the development of software solutions using the basic principles of software engineering. Train students to create programs using the procedural programming method. To acquaint students with different types of data, functions for data input and output, and different types of operators. Explain to the students program loops and commands for branching in the program. Show students the possibility of using 1D and 2D fields, explain the use of functions, working with memory, pointers, and ways of generating pseudo-random numbers.		
1.2. Course enrolment requirements		
Requirements for enrolment in the study programme fulfilled.		
1.3. Expected learning outcomes		
1. Recognize and interrelate the essential features of procedural programming and the structured program code. 2. Understand the algorithmic approach to solving problems and their writing in programming language using different data, control and structural elements. 3. Develop your own programming solution to the problem in a specific programming language and applying the basic principles of software engineering. 4. Test, analyse and fix the developed software solution to problems in the development environment.		
1.4. Course content		
Writing numbers and characters in the computer. Algorithmic approach to problem solving and complexity of algorithms. Basic language elements, lexical units, commands, program and basics of program architectures. Basic principles of software engineering. C programming language through examples: program structure, keywords, data types, constants and variables, operators, arithmetic and logical expressions, data input and output, branching and loops in the program, functions, fields and more complex data types, pointers. Working with strings. Preprocessor commands. Standard function libraries. Using standard functions: random numbers, timing, character strings. Examples of search and sort programs.		
1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☐ distance learning	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor

	☐ field work	☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE)	2	1, 2, 3, 4	Lectures (L), laboratory exercises (LE)	Attendance tracking. Minimum attendance percentage: 70%.	3	6
Problem-solving exercises	1	2, 3, 4	Revision exams (written exam)	Evaluation	15	30
Preparation for laboratory exercises (LE), results analysis, report writing	1	1, 3, 4	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	12	24
Preparing for an oral exam and oral exam	1	1, 2, 3	Oral exam	Evaluation	20	40

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. J. Šribar, B. Motik, Demistificirani C++, 3. dopunjeno izdanje, 2010.
2. S.G. Kochan, Programming in C (Developer's Library), 4th Ed., Addison-Wesley Professional, 2014.
3. D. Kusalić, Napredno programiranje i algoritmi u C-u i C++-u, Element, 2014.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. D. Patterson, J. Hennessy, Computer Organization and Design: The Hardware / Software Interface (5th. Edition), Morgan Kaufmann Publ., 2013.
2. A.S. Tanenbaum, T. Austin, Structured Computer Organization (6th Ed.), Pearson, 2012.
3. R. Sedgewick, K. Wayne, Algorithms (4th Ed.), Addison-Wesley Professional, 2011.
4. B. Stroustrup, Programming: Principles and Practice Using C++ (2nd Ed.), Addison-Wesley Professional, 2014.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
1. J. Šribar, B. Motik, Demistificirani C++, 3. dopunjeno izdanje, 2010.	20	260
2. S.G. Kochan, Programming in C (Developer's Library), 4th Ed., Addison-Wesley Professional, 2014.	5	260
3. D. Kusalić, Napredno programiranje i algoritmi u C-u i C++-u, Element, 2014.	10	260

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences
Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Petar Kerže, MKin, Senior Lecturer	
Course title	Physical Education I	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	1
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(0+(0+30+0)+0)

1. COURSE DESCRIPTION		
1.1. Course objectives		
The goals and tasks of physical and health culture derive from the goals and tasks of the general educational system, and the goals and tasks of the physical and health education field. They also arise from the role that this area plays in terms of its potential and necessary impact on changes in the anthropological status of students. The classes are conducted within certain homogenized groups, and according to the various preferences of students who express interest in specific sports.		
1.2. Course enrolment requirements		
Requirements for enrolment in the study programme fulfilled		
1.3. Expected learning outcomes		
1. Follow the guidelines and instructions about physical exercise and its importance for maintaining health and the impact on raising the level of quality of life. 2. Expand knowledge of a specific sport that is included in the curriculum, 3. Perform simple set tasks independently and as a team		
1.4. Course content		
The curriculum contains elements of team sports such as: basketball, volleyball, futsal, handball, table tennis tennis, badminton, free exercise without weights and elements of swimming, sports gymnastics and athletics. As part of the Physical Culture course, students are given the opportunity to participate in faculty teams at university competition. The university championship offers competitions in sports such as handball, futsal, football, basketball, volleyball, table tennis, swimming, chess, bowling, billiards, darts, cross country, 3x3 basketball and beach volleyball. In all the mentioned sports, a competition is held for male and female students.		
1.5. Types of classes	☐ lectures	☐ individual exercises

	☐ seminars and workshops ☐ auditory exercises ☒ distance learning ☐ field work	☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at laboratory exercises (LE)	1	1, 2, 3	Laboratory exercises (LE)	Attendance tracking. Minimum attendance percentage: 70%.	-	-

1.10. Obligatory literature (at the time of submitting a study programme proposal)

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1.11. Recommended additional literature (at the time of submitting a study programme proposal)

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1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Jerko Glavaš, PhD, Associate Professor	
Course title	Communication Skills	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	3
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	30 +(15+0+0)+0

2. COURSE DESCRIPTION		
1.14. Course objectives		
The objective of the course "Communication Skills" in the undergraduate study programme is to familiarise students with business communication and communication skills. Communication skills are part of the skill set ("tools") that direct the business and creative potentials of individuals and groups towards faster and more efficient solutions to economic and other problems at both the micro and macro levels, particularly organisations.		
1.15. Course enrolment requirements		
Requirements for enrolment in the study programme fulfilled.		
1.16. Expected learning outcomes		
1. Identify the basics of the communication process. 2. Demonstrate the forms and role of non-verbal communication. 3. Develop effective message structuring in public and written communication. 4. Combine listening and questioning skills. 5. Establish presentation and group communication skills. 6. Create a communication system using information and communication technologies.		
1.17. Course content		
The concept and processes of communication. Verbal and non-verbal communication. Principles of effective communication. Listening and questioning skills. Assertive communication. Public speaking. Presentation skills. Teamwork. Group communication. Conflict resolution. Negotiation skills. Meeting management. Written communication. Business etiquette and protocol. Business ethics.		
1.18. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☒ individual exercises ☐ multimedia and network ☐ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.19. Comments		
1.20. Student obligations		

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.21. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.22. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	1.5	1-6	Lectures (L), laboratory exercises (LE), design exercises (CE)	Attendance tracking. Minimum attendance percentage: 70%.	0	10
Problem-solving exercises	0.5	1,3	Revision exams (written exam)	Evaluation	20	40
Preparing for an oral exam and oral exam	1	1-6	Oral exam	Evaluation	25	50

1.23. Obligatory literature (at the time of submitting a study programme proposal)

1. BOVEE, Courtland L.; THILL, John V. Suvremena poslovna komunikacija
2. Guffey, Mary Ellen; Loewy Dana Business communication: Process and product
3. Borg, J. Govor tijela
   Gottesman, D., Mauro, B. Umijeće javnog nastupa

1.24. Recommended additional literature (at the time of submitting a study programme proposal)

1. Thun, F.S.von Kako međusobno razgovaramo, Smetnje i razjašnjenja
2. Vodopija, Š Opća i poslovna komunikacija
3. F. Vreg Humana komunikologija
4. Vodopija, Š Opća i poslovna komunikacija
5. Rouse J.R., Rouse, S. Poslovne komunikacije
6. Pease, A. & B. Body Language
7. Fox, R. Poslovna komunikacija
8. Pease A. & B. Komunikacija za sva vremena

1.25. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
BOVEE, Courtland L.; THILL, John V. Suvremena poslovna komunikacija	5	140
Guffey, Mary Ellen; Loewy Dana Business communication: Process and product	5	140
Borg, J. Govor tijela	5	140
Gottesman, D., Mauro, B. Umijeće javnog nastupa	5	140

1.26. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Anita Katić, PhD, Assistant Professor	
Course title	Calculus II	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	4
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	30+(30+0+0)+0

1. COURSE DESCRIPTION

1.1. Course objectives

Introduce students to the basic ideas and methods of integral calculus, differential equations, and series, and equip students to apply these concepts in creating and solving problems in their field.

1.2. Course enrolment requirements

There are no special requirements for enrolling in the course.

1.3. Expected learning outcomes

1. Present the properties of integrals, methods of integration, and the fundamental theorems of integral calculus.
2. Calculate indefinite and definite integrals.
3. Explain the meaning and application of the definite integral.
4. For a given problem, create an integral, solve it, and interpret the solution.
5. Explain the concept of convergence of series of numbers and functions, and apply basic criteria for testing convergence.
6. Create the Taylor series of a given function.
7. Demonstrate the skills of solving basic types of ordinary differential equations.
8. Create and solve a mathematical model based on differential equations that describe an example from the profession.

1.4. Course content

Riemann integral. The integral as an area. Concept and properties of the Riemann integral. Integrability of monotonic and continuous functions. The mean value theorem for integral of the continuous function. Newton-Leibniz formulae.
Indefinite integral. Basic methods and techniques of integration (the method of substitution, integration by parts, integration of rational functions and integration of functions boiling down to integrals of rational functions, Euler substitution, binomial integral)
Application of integration. Area of a pseudo trapezoid. Area between two curves, surface and volumes of revolution, length of curve. Improper integral.
Series of real numbers. Concept of series and convergence. Criteria of convergence.
Series of functions. Uniform convergence. Power series. Taylor series of elementary functions.
Ordinary differential equations. Example of ordinary differential equations. General and particular solution. Cauchy problem. Geometric point of view. Problem of sensitivity to a change of initial values. Some types of ordinary differential equations of the first order (exact, homogeneous, linear, Bernoulli equation). Examples and applications.

Ordinary differential equations of the second order. Some special types. Linear differential equation of the second order with constant coefficients. Examples and applications (harmonic oscillator).

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☐ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	1.5	1-8	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Homework assignments	0.5	2, 4, 5, 6, 8	Preparation for written knowledge assessment	Evaluation of solutions for a given problem	0	10
Problem-solving exercises	0.8	2, 4, 5, 6, 8	Revision exams (written exam)	Evaluation	20	40
Preparing for an oral exam and oral exam	1.2	1-8	Oral exam	Evaluation	25	50

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. B. P. Demidović, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke . Zagreb: Tehnička knjiga, 2003
2. D. Jukić, R. Scitovski, Matematika I, Odjel za matematiku, Osijek, 2000
3. I. Ivanšić, Fourierovi redovi. Diferencijalne jednadžbe, Odjel za matematiku, Osijek, 2000

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. W. Rudin, Principles of Mathematical Analysis, Mc Graw-Hill, Book Company, New York, 1964

2. S. Kurepa, Matematička analiza 1 (diferenciranje i integriranje), Tehnička knjiga, Zagreb, 1989.

3. S. Kurepa, Matematička analiza 2 (funkcije jedne varijable), Tehnička knjiga, Zagreb, 1990

4. G. F. Simmons, J. S. Robertson, Differential Equations with Applications and Historical Notes, 2nd Ed., McGraw-Hill, Inc., New York, 1991

5. Schaum's outline series, McGRAW-HILL, New York, 1991.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
B. P. Demidović, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke	15	140
D. Jukić, R. Scitovski, Matematika I	15	140
I. Ivanšić, Fourierovi redovi. Diferencijalne jednadžbe	15	140

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Josip Job, PhD, Associate Professor	
Course title	Programming II	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	30+(15+0+30)+0

1. COURSE DESCRIPTION

1.1. Course objectives

The aim of the course is to equip students with the ability to apply procedural programming languages in practice by acquiring theoretical knowledge and solving tasks.

1.2. Course enrolment requirements

Requirements for enrolment in the study programme fulfilled.

1.3. Expected learning outcomes

1. Describe the mechanisms of function calls and argument passing.
2. Develop a program solution for managing different types of files.
3. Manage pointers and dynamic memory allocation.
4. Understand and use advanced syntactic constructs in the target programming language.
5. Propose a program solution based on complex types and data structures.
6. Organize program code based on function calls and argument passing.

1.4. Course content

Definition, declaration. Data type conversion. Scope and duration. Qualifiers. Complex data types: arrays, structures, and unions. Data alignment and structure packing. Pointers: relation to arrays, pointer arithmetic. Memory management. Parameter passing by value and by address. Text and binary files, sequential and direct access. Organizing program code into multiple files. The process of compiling program code. Application of the C programming language on different computer platforms. Code portability.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	1,4	1,2,3,4,5,6	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	1	1,2,3,4,5,6	Revision exams (written exam)	Evaluation	15	30
Preparation for laboratory exercises (LE), results analysis, report writing	1	1,2,3,4,5,6	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	15	30
Activity during classes, solving project tasks	0,6	1,2,3,4,5,6	Tasks	Knowledge assessment during lectures/exercises, checking written answers or solutions to tasks	0	10
Preparing for an oral exam and oral exam	1	1,2,3,4,5,6	Oral exam	Evaluation	15	30

1.10. Obligatory literature (at the time of submitting a study programme proposal)
1. C11 - ISO/IEC 9899:201x Committee Draft April 12, 2011 N1570, International Organization for Standardization/International Electrotechnical Commission, 2011.
1.11. Recommended additional literature (at the time of submitting a study programme proposal)
1. Brian W. Kernighan, Dennis M. Ritchie, C Programming Language, 2nd Edition, Prentice Hall; 2nd edition (April 1, 1988) 2. Fischer, Zbirka zadataka iz C-a, ETF Osijek (Zavodska skripta), 1999.
1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
1. C11 - ISO/IEC 9899:201x Committee Draft April 12, 2011 N1570, International Organization for Standardization/International Electrotechnical Commission, 2011.	140 (online)	140

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences
Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Petar Kerže, MKin, Senior Lecturer	
Course title	Physical education II	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	1
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(0+(0+30+0)+0)

1. COURSE DESCRIPTION
1.1. Course objectives
The goals and tasks of physical and health culture derive from the goals and tasks of the general educational system, and the goals and tasks of the physical and health education field. They also arise from the role that this area plays in terms of its potential and necessary impact on changes in the anthropological status of students. The classes are conducted within certain homogenized groups, and according to the various preferences of students who express interest in specific sports.
1.2. Course enrolment requirements

Requirements for enrolment in the study programme fulfilled

1.3. Expected learning outcomes

1. Follow the guidelines and instructions about physical exercise and its importance for maintaining health and the impact on raising the level of quality of life.

2. Expand knowledge of a specific sport that is included in the curriculum,

3. Perform simple set tasks independently and as a team

1.4. Course content

The curriculum contains elements of team sports such as: basketball, volleyball, futsal, handball, table tennis tennis, badminton, free exercise without weights and elements of swimming, sports gymnastics and athletics.

As part of the Physical Culture course, students are given the opportunity to participate in faculty teams at university competition. The university championship offers competitions in sports such as handball, futsal, football, basketball, volleyball, table tennis, swimming, chess, bowling, billiards, darts, cross country, 3x3 basketball and beach volleyball. In all the mentioned sports, a competition is held for male and female students.

1.5. Types of classes	☐ lectures ☐ seminars and workshops ☐ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at laboratory exercises (LE)	1	1, 2, 3	Laboratory exercises (LE)	Attendance tracking. Minimum attendance percentage: 70%.	-	-

1.10. Obligatory literature (at the time of submitting a study programme proposal)

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1.11. Recommended additional literature (at the time of submitting a study programme proposal)

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1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences
Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Tomislav Matić (Sr.), PhD, Full Professor, Davor Vinko, PhD, Associate Professor	
Course title	Basics of Electronics	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(45+(30+15+0)+0)

1. COURSE DESCRIPTION
1.1. Course objectives
To provide students with knowledge of the physical principles of semiconductor components and basic electronic circuits. To explain to students how to analyse the functioning of electronic components and their appropriate application in electronic circuits.
1.2. Course enrolment requirements
Requirements for enrolment in the study programme fulfilled.
1.3. Expected learning outcomes
1. Analysis and evaluation of the physical processes in semiconductor material without and under the influence of an electric field. 2. Evaluate the rectifying effect of the pn junction and the metal-semiconductor junction. 3. Analyze and evaluate the operation of a semiconductor diode under static and dynamic conditions. 4. Analyze and evaluate the operation of basic optoelectronic semiconductor devices. 5. Analyze and evaluate the operation of the bipolar transistor under static and dynamic conditions. 6. Analyze and evaluate the operation of unipolar transistors under static and dynamic conditions. 7. Measure the current-voltage characteristics of basic semiconductor elements. 8. Analyze and evaluate the operation of the basic components of power electronics.

9. Analyzing and evaluating the functioning of basic logic circuits.

1.4. Course content

Physical principles of semiconductors. Generation of charge carriers. The technology of manufacturing integrated circuits. Components of bipolar and unipolar integrated circuits: Transistors, diodes, resistors, capacitors. Current conduction mechanisms in semiconductors. pn junction and metal-semiconductor junction. Static and dynamic properties of pn junctions and metal-semiconductor junctions. Semiconductor diodes: static properties, dynamic properties, types of semiconductor diodes. Diode as rectifier. Bipolar transistor (BT): operating principle, static current-voltage characteristics, dynamic models, frequency dependence of parameters. Darlington junction, BJT as a switch, BJT as an amplifier, junction FET and MOSFET: operating principle, static current-voltage characteristics, dynamic model, frequency dependence of the parameters. MOSFET as a switch, MOSFET as an amplifier, optoelectronic components, basic CMOS circuits: digital and analog.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	0.8	1,2,3,4,5,6,8,9	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	2.2	3,4,5,6,8,9	Revision exams (written exam)	Evaluation	20	40
Preparation for laboratory exercises (LE), results analysis, report writing	1	3,4,5,6,7	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	10	20

Preparing for an oral exam and oral exam	2	1,2,3,4,5,6,8,9	Oral exam	Evaluation	20	40	

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Švedek, T. Poluvodičke komponente i osnovni sklopovi, Svezak I, Poluvodičke komponente
2. P. Biljanović Elektronički sklopovi

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. A.S. Sedra, K.C.Smith Microelectronic Circuits, 3. Edition

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Švedek, T. Poluvodičke komponente i osnovni sklopovi, Svezak I, Poluvodičke komponente	15	140
P. Biljanović Elektronički sklopovi	10	140

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Željko Hederić, PhD, Full Professor, Marinko Barukčić, PhD, Associate Professor	
Course title	Fundamentals of Electrical Engineering II-ET	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Electrical Engineering	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + (auditory exercises + laboratory exercises + design exercises) + seminars)	(45+(30+15+0)+0)

1. COURSE DESCRIPTION

1.1. Course objectives

To provide students with the competencies needed for applying the fundamental laws of electromagnetism for the purposes of modeling physical phenomena in static electromagnetic fields

1.2. Course enrolment requirements

Requirements for enrolment in the study programme fulfilled.

1.3. Expected learning outcomes

- Ohm's law in its elementary form, explanation of the models of electrical resistance, capacitance, inductance and mutual inductance by applying the electromagnetic field theory.
- Material in an electromagnetic field, generalized form of Gauss's and Ampère's law, the concept of polarization, influence, magnetization, magnetic hysteresis, polarization and magnetization vectors and the electric and magnetic dipole.
- Energy of the electromagnetic field, calculation of the energy of the electric and magnetic fields using capacitance, inductance and the quantities of electric and magnetic fields.
- Forces in the electromagnetic field, change in the energy of the electromagnetic field.
- Determination of voltage in an electrostatic field, magnetic flux in a magnetic field, capacitance (single-layer and multi-layer dielectric), inductance and mutual inductance using the quantities of electric and magnetic fields (with examples of capacitors, conductors and coils).
- Electrostatic (capacitive) electrical networks in steady-state conditions.
- The concept of a magnetic circuit (simple and complex), application of Ampère's law to solve magnetic circuits.
- Mathematical modelling of magnetic circuits.
- Determination of induced voltage using Faraday's law.
- Introduction to the visualization of electromagnetic fields and solving problems in the electromagnetic field using computer tools.

1.4. Course content

Introducing students to the basic laws of electromagnetism, quantities and units that describe electric and magnetic fields. To train students to analyze and solve electrical networks of DC and alternating currents and voltages in the molten state. To train students to connect simple electrical circuits and carry out measurements of basic electromagnetic quantities. To introduce students to the designs, methods of operation and application of basic types of electrical machines.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☒ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE)	2	1 ,2 ,3, 4	Lectures (L), auditory exercises (AE), laboratory exercises (LE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0

Problem-solving exercises	1	2, 4	Revision exams (written exam)	Evaluation	20	40
Preparation for laboratory exercises (LE), results analysis, report writing	1	5	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	5	10
Independent work	1	2,4	Instructions and tasks for independent work	Verification and explanation of the results of independent work	5	10
Preparing for an oral exam and oral exam	1	1, 2, 3, 4	Oral exam	Evaluation	20	40

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Kuzmanović, B. Osnove elektrotehnike I i II
2. Šehović, Felja, Tkalić Osnove elektrotehnike zbirka primjera prvi dio
3. Felja, Koračin, Zbirka zadataka i riješenih primjera iz Osnova elektrotehnike, I. i II. Dio
4. Hederić, Željko; Snježana Rimac-Drlje; Barukčić, Marinko Osnove elektrotehnike I. Priručnik za laboratorijske vježbe
5. Hederić, Željko; Barukčić, Marinko Osnove elektrotehnike II. Priručnik za laboratorijske vježbe

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. V. Pinter Osnove elektrotehnike I i II
2. B. Kuzmanović Zbirka zadataka i pitanja iz Osnova elektrotehnike 1 i 2
3. J. Edminister Outline of Electromagnetics

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Kuzmanović, B. Osnove elektrotehnike I i II Zagreb: Element, 2000.	40	120
Šehović, Felja, Tkalić Osnove elektrotehnike zbirka primjera prvi dio Školska knjiga, Zagreb, 1992.	20	120
Felja, Koračin, Malić Zbirka zadataka i rješenih primjera iz Osnova elektrotehnike, I. i II. dio 1991	40	120

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Marina Skender, PhD, Assistant Professor
Course title	Introduction to Mechanics and Electromagnetism
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering
Course status	Compulsory

Year of study	1	
ECTS credits and teaching methods	ECTS credits	8
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(50 + 25 + 15 + 0 + 0)

1. COURSE DESCRIPTION		
1.1. Course objectives		
This course is an introduction to the kinematics, dynamics, and conservation laws of a small body or particle. The laws of mechanics are applied to a harmonic oscillator and waves. The introduction of electromagnetism is given and is focused on the derivation of the Maxwell's equations in integral form. The graphic tools and advanced mathematics are applied in problem-solving of the mentioned areas in the course.		
1.2. Course enrolment requirements		
Requirements for enrolment in the study programme fulfilled.		
1.3. Expected learning outcomes		
It is expected that the student will be able to: 1. describe, derive and evaluate kinematic variables in one, two and three dimensions 2. analyse simple mechanical systems using Newton's laws 3. apply the energy and momentum-conservation laws to simple mechanical systems 4. determine the principles of mechanics on a simple harmonic oscillator 5. describe the principles of wave mechanics 6. define and explain terms as: elementary charge, Coulomb force, electric field and potential 7. explain and apply Gauss's law of the electric field to selected problems 8. derive the magnetic field of a straight conductor and explain and apply Biot-Savart's and Ampère's laws to selected problems 9. derive and explain the Maxwell-Ampère's law 10. explain and apply Faraday's law of induction to selected problems 11. explain Gauss's law of the magnetic field 12. explain and apply Maxwell's equations to get the wave equation for an electromagnetic wave		
1.4. Course content		
Introduction to mechanics and electromagnetism.		
1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		
1.7. Student obligations		
Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.		
1.8. Monitoring and assessment of student work		

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	2	1, 2, 3, 7, 8, 9	Revision exams (written exam)	Evaluation	20	40
Preparation for laboratory exercises (LE), results analysis, report writing	0,5	1, 2, 3, 4	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	5	10
Preparing for an oral exam and oral exam	2,5	1, 5, 8, 9, 10, 11, 12	Oral exam	Evaluation	25	50

1.10. Obligatory literature (at the time of submitting a study programme proposal)

D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics 9th ed., Wiley & Sons, 2011, Vol.1 & Vol. 2.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

D. . Horvat (2011.), Fizika 2: titranje, valovi, elektromagnetizam, optika i uvod u modernu fiziku, Neodidakta

V. Henč-Bartolić, P. Kulišić (1991.), Valovi i optika, Školska knjiga

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics 9th ed., Wiley & Sons, 2011, Vol.1 & Vol. 2.	15	80

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Željko Hederić, PhD, Full Professor, Marinko Barukčić, PhD, Associate Professor	
Course title	Fundamentals of Electrical Engineering II -IKT	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Information and Communication Technology	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + (auditory exercises + laboratory exercises + design exercises) + seminars)	(45+(30+15+0)+0)

1. COURSE DESCRIPTION
1.1. Course objectives
To provide students with the skills required to apply the fundamental laws of electromagnetism for the purpose of modelling physical phenomena in a time-stable electromagnetic field, as well as the skills to solve simple transition states and frequency analysis in electrical circuits.
1.2. Course enrolment requirements
Requirements for enrolment in the study programme fulfilled.
1.3. Expected learning outcomes
Demonstrate the basic physical quantities that represent the phenomenon of the electric field at constant charge, the phenomenon of the magnetic field at constant current and the phenomenon of electromagnetic induction. Apply the basic laws of electromagnetism to solve simple and intermediate problems of constant charge electric field, constant current magnetic field and electromagnetic induction. Evaluate physical phenomena in isotropic matter (polarisation, magnetisation, hysteresis loop). Evaluate analytical mathematical models of magnetic circuits. Compare the results of measurements of basic electrical and magnetic quantities with the results of analytical and graphical calculations. Evaluate mathematical models for solving transition states in simple electrical circuits Analyse the frequency response of an electrical circuit
1.4. Course content
Ohm's law in elementary form, explanation of the models of electrical resistance, capacitance, inductance and interinductance by applying the theory of the electromagnetic field Material in an electromagnetic field, generalised Gauss' and Ampère's laws, the concept of polarisation, influence, magnetisation, magnetic hysteresis, polarisation and magnetisation vectors and electric and magnetic dipoles Electromagnetic field energy, calculation of electric and magnetic field energy using capacitance, inductance and the quantities of electric and magnetic fields Forces in an electromagnetic field, changing the energy of an electromagnetic field Determining the voltage in an electrostatic field, the magnetic flux in a magnetic field, the capacitance (single and multi-layer dielectric), the inductance and the intermediate inductance using the quantities of the electric and magnetic field (using the example of capacitors, cables and windings) Static electrostatic (capacitive) electrical networks The concept of the magnetic circuit (simple and complex), application of Ampere's law to the solutions of magnetic circuits Mathematical modelling of magnetic circuits

Determining the induced voltage using Faraday's law Transients in first-order electric circuits		
1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☒ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	2.0	1, 2, 3, 4	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	1.0	2, 4	Revision exams (written exam)	Evaluation	20	40
Preparation for laboratory exercises (LE), results analysis, report writing	1.0	5	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	5	10
Independent work	1.0	2, 4	Instructions and tasks for independent work	Verification and explanation of the results of independent work	5	10
Preparing for an oral exam and oral exam	1.0	1,2, 3, 4,	Oral exam	Evaluation	20	40

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Kuzmanović, B. Fundamentals of Electrical Engineering I and II
2. Šehović, Felja, Tkalić Fundamentals of Electrical Engineering A Collection of Examples Part One
3. Felja, Korakin, A Collection of Tasks and Solved Examples from the Basics of Electrical Engineering, Part I and II

4. Hederić, Željko; Snježana Rimac-Drlje; Barukčić, Marinko Basics of Electrical Engineering I. Manual for Laboratory Exercises
5. Hederić, Željko; Barukčić, Marinko Fundamentals of Electrical Engineering II. Laboratory Practice Manual

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. W. Pinter Fundamentals of Electrical Engineering I and II
2. B. Kuzmanović Collection of Tasks and Questions from Fundamentals of Electrical Engineering 1 and 2
3. J. Edminister Outline of Electromagnetics

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Kuzmanović, B. Fundamentals of Electrical Engineering I and II	40	120
Šehović, Felja, Tkalić Fundamentals of Electrical Engineering A Collection of Examples Part One	20	120
Felja, Koracin, A Collection of Tasks and Solved Examples from the Basics of Electrical Engineering, Part I and II	20	120

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Marina Skender, PhD, Assistant Professor	
Course title	Engineering Mechanics	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Information and Communication Technology	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	8
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(50 + 25 + 15 + 0 + 0)

1. COURSE DESCRIPTION

1.1. Course objectives

This course is an introduction to mechanics, with a focus on the kinematics, dynamics, and conservation laws of a small body or particle. The rotation of rigid bodies and their equilibrium conditions are described. The fluid mechanics is explained in a simple terms. Furthermore, the mechanic-laws are applied to a harmonic oscillator and waves. The thermodynamics is explained and the complementary laws are established. The analysis of reversible thermodynamic processes is emphasised.
The graphic tools and advanced mathematics are applied in problem-solving of the mentioned areas in the course.

1.2. Course enrolment requirements

Requirements for enrolment in the study programme fulfilled.

1.3. Expected learning outcomes

It is expected that the student will be able to:

1. describe, derive and evaluate kinematic variables in one, two and three dimensions
2. analyse simple mechanical systems using Newton's laws
3. apply the energy and momentum-conservation laws to simple mechanical systems
4. apply advanced mathematics to problem-solving and determine the centre of mass of rigid bodies
5. use graphic analysis in problem-solving
6. determine the principles of mechanics on complex mechanical systems, simple harmonic oscillator and waves
7. apply the equation of motion for body rotation around a fixed axis
8. explain the conditions for static equilibrium of a rigid body
9. apply the Bernoulli's equation and the continuity equation to simple systems in fluid mechanics
10. evaluate fundamental physical phenomena, quantities and laws in the field of thermodynamics
11. mathematically formulate simple physical problems in thermodynamics
12. critically evaluate the kinetic molecular theory

1.4. Course content

Introduction to mechanics.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	3	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	2	1, 2, 3, 7, 8, 9	Revision exams (written exam)	Evaluation	20	40

Preparation for laboratory exercises (LE), results analysis, report writing	0,5	1, 2, 3, 4	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	5	10
Preparing for an oral exam and oral exam	2,5	1, 5, 8, 9, 10, 11, 12	Oral exam	Evaluation	25	50

1.10. Obligatory literature (at the time of submitting a study programme proposal)

Halliday, D.; Resnick, R.;Walker, J.: Fundamentals of Physics, 9th ed., Wiley & Sons, Vol. 1 & Vol. 2, 2011.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

P. Kulišić, Mehanika i toplina, Školska knjiga, Zagreb, 2005.

P. Kulišić et al., Riješeni zadaci iz mehanike i topline, Školska knjiga, Zagreb, 1996.

Ž. Mioković, Fizika 1, Priručnik za laboratorijske vježbe, Sveučilište „J.J. Strossmayera" u Osijeku, ETF, 2013.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics 9th ed., Wiley & Sons, 2011, Vol.1 & Vol. 2.	15	40

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Tomislav Marošević, PhD, Associate Professor	
Course title	Calculus III	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	45+(30+0+0)+0

1. COURSE DESCRIPTION

1.1. Course objectives

To acquaint students with the differential and integral calculus of real functions and vector functions of several real variables, and with the basics of the theory of complex functions of a complex variable.

1.2. Course enrolment requirements

Requirements for enrolment in the second year of study fulfilled.

1.3. Expected learning outcomes

1. present the basic theorems of the differential calculus of several variables, calculate partial derivatives and differentials of the first and higher order for functions of several variables, and apply Taylor's formula of functions of several variables to approximate functions
2. calculate extrema of function of several variables and conditional extrema
3. apply double integrals for calculating surface areas, volumes and masses of bodies, and analogously for triple integrals
4. formulate the basic theorems of the theory of scalar and vector fields and interpret the physical meaning of gradient, directional derivative, divergence and curl of a vector field
5. calculate curve and surface integrals for scalar and vector functions, and apply the divergence theorem and Stokes theorem in some problems in physics and electrical engineering
6. formulate the basic theorems of the theory of the function of a complex variable and, using the Cauchy-Riemann equations, conclude whether a given complex function is differentiable
7. calculate the integral of a function of a complex variable
8. distinguish the type of isolated singularity of an analytic function, and apply the residue theorem for calculating integrals of functions of a complex variable.

1.4. Course content

Real functions of several real variables. Level curves and level surfaces. Limits and continuity. Partial derivatives and differential. Equation of tangent plane to a surface. Partial derivatives of composite functions and implicit functions. Partial derivatives and differentials of higher orders. Taylor's formula for functions of several variables. Extrema and conditional extrema of functions of several variables. Double and triple integrals - basic concepts, calculation and applications. Line integrals (of the first and of the second kind) – definition, properties, calculation and applications. Surface integrals (of the 1. and the 2. kind).
Vector functions of several variables. Scalar and vector field. Gradient of a scalar field; divergence of a vector field; curl of a vector field; applications.
Complex functions of a complex variable. Derivative of a complex function. Integral of function of a complex variable. Cauchy theorem and integral formula. Taylor and Laurent series. Singularities. Residues.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☐ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max

Attendance at lectures (L), auditory exercises (AE),	1	1,2,3,4,5,6,7,8	Lectures (L), laboratory exercises (LE	Attendance tracking. Minimum attendance percentage: 70%.	5	10
Problem-solving exercises	2	1,2,3,4,5,6,7,8	Revision exams (written exam)	Evaluation	20	45
Preparing for an oral exam and oral exam	2	1,2,3,4,5,6,7,8	Oral exam	Evaluation	20	45

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. P. Javor, Matematička analiza II, Element, Zagreb, 2000.
2. B. P. Demidović, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke, Tehnička knjiga, Zagreb, 2003.
3. R. Galić, Funkcije kompleksne varijable – za studente tehničkih fakulteta, Elektrotehnički fakultet Osijek, 1994.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. S. Kurepa, Matematička analiza 3 (funkcije više varijabli), Tehnička knjiga, Zagreb, 1979.
2. M. Krasnov et al., Mathematical Analysis for Engineers - Vol. 1 & ibid. Vol. 2, Mir Publishers, Moscow, 1990.
3. N. Elezović, D. Petrizio, Funkcije kompleksne varijable: zbirka zadataka, Element, Zagreb, 1994.
4. T. Marošević, Matematika III - lecture presentations in pdf format, available in the course Mathematics III FERIT Osijek in the Merlin e-learning system

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
P. Javor, Matematička analiza II, Element, Zagreb, 2000.	10	85
B. P. Demidović, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke, Tehnička knjiga, Zagreb, 2003	10	85
R. Galić, Funkcije kompleksne varijable – za studente tehničkih fakulteta, Elektrotehnički fakultet Osijek, 1994.	15	85

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Petar Kerže, MKin, Senior Lecturer	
Course title	Physical education III	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	2	
	ECTS credits	1

ECTS credits and teaching methods	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(0+(0+30+0)+0)

1. COURSE DESCRIPTION		
1.1. Course objectives		
The goal and tasks of physical and health culture derive from the goals and tasks of the general educational system, and from the goals and tasks of the physical and health education field. They also derive from the role that it the area has a possible and necessary influence on changes in the anthropological status of students. It continues performed within certain homogenized groups, and according to the different wishes of the students who express interest in certain sports		
1.2. Course enrolment requirements		
Requirements for enrolment in the study programme fulfilled		
1.3. Expected learning outcomes		
1. Follow the guidelines and instructions about physical exercise and its importance for maintaining health and the impact on raising the level of quality of life. 2. Expand knowledge of a specific sport that is included in the curriculum, 3. Perform simple set tasks independently and as a team		
1.4. Course content		
The curriculum contains elements of team sports such as: basketball, volleyball, futsal, handball, table tennis tennis, badminton, free exercise without weights and elements of swimming, sports gymnastics and athletics. As part of the Physical Culture course, students are given the opportunity to participate in faculty teams at university competition. The university championship offers competitions in sports such as handball, futsal, football, basketball, volleyball, table tennis, swimming, chess, bowling, billiards, darts, cross country, 3x3 basketball and beach volleyball. In all the mentioned sports, a competition is held for male and female students.		
1.5. Types of classes	☐ lectures ☐ seminars and workshops ☐ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		
1.7. Student obligations		
Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.		
1.8. Monitoring and assessment of student work		
Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.		
1.9. Assessment and evaluation of student work during classes and in the final exam		

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at laboratory exercises (LE)	1	1, 2, 3	Laboratory exercises (LE)	Attendance tracking. Minimum attendance percentage: 70%.	-	-

1.10. Obligatory literature (at the time of submitting a study programme proposal)

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1.11. Recommended additional literature (at the time of submitting a study programme proposal)

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1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Kruno Miličević, PhD, Full Professor	
Course title	Basics of Metrology	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Electrical Engineering	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	7
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(45+(15+30+0)+0)

1. COURSE DESCRIPTION

1.1. Course objectives

Present the theoretical basis of metrology, measuring devices, and methods to students through lectures. Demonstrate examples of calculating measurement uncertainty and other data relevant to the measurement process through classroom exercises. Provide students with hands-on experience with measuring instruments through laboratory exercises.

1.2. Course enrolment requirements

Requirements for enrolment in the second year of study fulfilled.

1.3. Expected learning outcomes

1. Understand and interrelate the basic concepts in metrology, and evaluate their significance in engineering practice.
2. Assess measurement uncertainty, and systematic and random errors.
3. Analyze the principles of operation of analog and digital measuring instruments and evaluate their impact on measurement uncertainty.
4. Select the optimal measurement method and conduct measurements of electrical quantities in a safe manner, adhering to occupational safety regulations.
5. Evaluate measuring transducers and methods for measuring non-electrical physical quantities.
6. Assess the role of software and hardware in measurements and define the basic components of an automated measurement system.

1.4. Course content

Basic concepts in metrology. Measurement unity, metrological pyramid, traceability. International System of Units. Ratio units. Errors. Measurement uncertainty. Complete measurement result. Decision making based on the complete measurement result. Types of signals, their parameters, and representation in the time and frequency domains. Measuring equipment. Meters (analog electromechanical, analog electronic, digital). Digital multimeter. Oscilloscope, measuring probes. Parts of a digital measuring device (measuring transducer, adapter, analog-to-digital converter, display). Measurement methods (deflection, null, comparative, transfer, differential, direct, indirect). Measurement of electrical quantities (current, voltage, frequency, phase shift, apparent power, active power, reactive power, power factor, energy, resistance, inductance, capacitance and loss factor, impedance and admittance, harmonic content of signals). Software and hardware in measurements. Computer-controlled measurement systems (automated measurements, overview of software packages for measurement automation, monitoring systems, expert diagnostic systems). Measuring transducers. Measurements of some non-electrical quantities.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☐ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at	2,2	1,2,3,4,5,6	Lectures (L),	Attendance tracking. Minimum	0	0

lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)			laboratory exercises (LE), design exercises (DE)	attendance percentage: 70%.		
Problem-solving exercises	1	2,3,5	Revision exams (written exam)	Evaluation	15	30
Preparation for laboratory exercises (LE), results analysis, report writing	2,1	2,3,4,5,6	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	15	30
Preparing for an oral exam and oral exam	1,5	1,2,3,4,5,6	Oral exam	Evaluation	15	30
Group tasks during lectures	0,2	2,3,4	Group tasks	Verification of solutions and discussion with students	0	10

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Smith, R.C. Uncertainty Quantification, SIAM 2013
2. R. Malarić Instrumentation and measurement in electrical engineering, Brown Walker Press (April 20, 2011)
3. Z. Godec Iskazivanje mjernog rezultata, ETF Osijek, 1995
4. Z. Godec, D. Dorić Osnove mjerenja, laboratorijske vježbe, ETF Osijek, 1998
5. Z. Godec, D. Dorić Električka mjerenja s laboratorijskim vježbama, ETF Osijek, 1998

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. D. Vujević, B. Ferković Osnove elektrotehničkih mjerenja I i II
2. V. Bego Mjerenja u elektrotehnici
3. D. Karavidović Električna mjerenja I i II
4. Šantić Elektronička instrumentacija

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Smith, R.C. Uncertainty Quantification, SIAM 2013	2	60
R. Malarić Instrumentation and measurement in electrical engineering, Brown Walker Press (April 20, 2011)	2	60
Z. Godec Iskazivanje mjernog rezultata, ETF Osijek, 1995	2	60
Z. Godec, D. Dorić Osnove mjerenja, laboratorijske vježbe, ETF Osijek, 1998	10	60
Z. Godec, D. Dorić Električka mjerenja s laboratorijskim vježbama, ETF Osijek, 1998	10	60

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Kruno Miličević, PhD, Full Professor, Denis Pelin, PhD, Full Professor	
Course title	Theory of Electrical Networks	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Electrical Engineering	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(45+(30+0+0)+0)

1. COURSE DESCRIPTION		
1.1. Course objectives		
The aim of the course is to clarify for students the difference between actual electrical networks and mathematical models, and to explain the conditions under which a specific model can be used, such as Maxwell's or Kirchhoff's model. For Kirchhoff's model, various methods for solving electrical networks will be presented, taking into account the specific properties of the network elements and the network as a whole, and analyzing the physical foundation of the network's response.		
1.2. Course enrolment requirements		
Requirements for enrolment in the second year of study fulfilled.		
1.3. Expected learning outcomes		
1. Select and apply the appropriate method for solving and analyzing linear and time-invariant electrical networks to determine time responses. 2. Evaluate the solutions obtained from network analysis. 3. Apply network theorems and assess the obtained results. 4. Calculate immittance functions and transfer functions, and based on that, evaluate the frequency behavior of networks. 5. Calculate the basic parameters of two-port networks.		
1.4. Course content		
1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☐ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		
1.7. Student obligations		
Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.		

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	1,3	1, 2, 3, 4, 5	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	2	1, 3, 4, 5	Revision exams (written exam)	Evaluation	20	40
Preparing for an oral exam and oral exam	2,5	1, 2, 3, 4, 5	Oral exam	Evaluation	25	50
Group tasks during lectures	0,2	1, 2	Group tasks	Verification of solutions and discussion with students	0	10

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Flegar, I. Teorija mreža : Bilješke s predavanja, Elektrotehnički fakultet Osijek, 2001
2. Robbins, Allan H. Circuit Analysis: Theory & Practice, 3E, Delmar Cengage Learning; 3rd edition (July 7, 2003)
3. I. Flegar Teorija mreža-Zbirka zadataka, Elektrotehnički fakultet Osijek, 2001

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. L.O. Chua, C.A. Desoer, E.S. Kuh Linear and nonlinear circuits, McGraw-Hill College; 1st Ed. edition (March 1, 1987)
2. J.W. Nilsson, S.A Riedel Electric circuits, Pearson; 10th edition (December 17, 2019)

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
1. Flegar, I. Teorija mreža : Bilješke s predavanja, Elektrotehnički fakultet Osijek, 2001	10	60
2. Robbins, Allan H. Circuit Analysis: Theory & Practice, 3E, Delmar Cengage Learning; 3rd edition (July 7, 2003)	5	60
3. I. Flegar Teorija mreža-Zbirka zadataka, Elektrotehnički fakultet Osijek, 2001	10	60

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Marinko Stojkov, PhD, Full Professor, Marina Skender, PhD, Assistant Professor	
Course title	Energy Conversions	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Electrical Engineering	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	45+(30+0+0)+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Introduction to basic knowledge of energy conversions: basic physical laws and physical problems in the field of thermodynamics, circular processes in thermodynamics, heat transfer and combustion, processes in a real steam thermal power plant.		
1.2. Course enrolment requirements		
Requirements for enrolment in the second year of study fulfilled.		
1.3. Expected learning outcomes		
1. Evaluate basic physical phenomena, quantities and laws in the field of thermodynamics. 2. Evaluate the fundamental laws of thermodynamics for the calculation of physical quantities of states and individual forms of energy. 3. Critically comprehend the kinetic-molecular theory of gases. 4. Identify and interpret basic physical terms and definitions related to heat, internal energy and mechanical work obtained, enthalpy and entropy, heat reservoirs and specific heat capacity of fluids. 5. Numerically evaluate and model (with a mathematical model and graphically appropriate diagrams) the basic thermodynamic processes of an ideal gas and circular processes in thermodynamics. 6. Evaluate closed and open systems in energy with application to thermal power plant subsystems and changes in the aggregate state and the thermal degree of useful action. 7. Assess the nature of heat transfer and combustion with application. 8. Evaluate energy conversions based on thermodynamic examples applied in a real thermal power plant.		
1.4. Course content		
About matter and energy. Division of energy forms. Production of electricity from internal energy. Fluid properties. State quantities and definitions of thermodynamic systems. The first law of thermodynamics for closed and open systems. Kinetic-molecular theory of gases. An ideal gas and an ideal liquid. Laws of behavior of (ideal) gas and liquid and their mixtures. Circular process of closed and open systems. Thermal tanks. Thermal (energy) degree of action and the second law of thermodynamics. Entropy and enthalpy. Determination of exergy and exergy losses. Exergy-based degree of action. Aggregate conversions. Processes in steam and gas thermal power plants. Application to thermal power plant subsystems. Energy relations in steam and gas turbines: power and energy equations. General about heat transfer: methods of heat exchange. Heat conduction. Heat transfer by natural and forced convection. Heat radiation. Complete and incomplete combustion.		
1.5. Types of classes	☒ lectures ☐ seminars and workshops	☐ individual exercises ☐ multimedia and network

	☒ auditory exercises ☒ distance learning ☐ field work	☐ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE)	2	1, 2, 3, 4, 5, 6, 7, 8	Lectures (L), Auditory exercises (AE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	1	2, 4, 5, 6, 7	Control tasks - assignments (written exam)	Evaluation of solved tasks	15	30
Written test - theory	1	1, 2, 3, 4, 5, 6	Control tasks - theory	Evaluation of question marks	10	20
Preparing for the oral exam and answering questions orally	2	1, 2, 3, 4, 5, 6, 7, 8	Oral exam	Evaluation of the given theory answers	25	50

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. H. Požar: Osnove energetike 1, Školska knjiga, Zagreb, 1992.
2. H. Požar: Osnove energetike 2, Školska knjiga, Zagreb, 1992.
3. B. Udovičić: Energetika, Školska knjiga, Zagreb, 1993.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. F. Bošnjaković: Nauka o toplini, I dio, Tehnička knjiga, Zagreb, 1990.
2. F. Bošnjaković: Nauka o toplini, II dio, Tehnička knjiga, Zagreb, 1990.
3. A. Galović: Termodinamika I Sveučilište u Zagrebu, Fakultet strojarstva i brodogradnje, Zagreb, 2002.
4. A. Galović: Termodinamika II Sveučilište u Zagrebu, Fakultet strojarstva i brodogradnje, Zagreb, 2003.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
1. H. Požar: Osnove energetike 1, Školska knjiga, Zagreb, 1992.	10	60
2. H. Požar: Osnove energetike 2, Školska knjiga, Zagreb, 1992.	10	60
3. B. Udovičić: Energetika, Školska knjiga, Zagreb, 1993.	10	60

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences
Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Goran Rozing, PhD, Assistant Professor	
Course title	Electrical Engineering Materials	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Electrical Engineering	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	30+(15+15+0)+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
To acquaint students with basic engineering materials and technologies and train them for the proper selection and application of conductive, semi-conductive, insulating and magnetic materials in electrical engineering.		
1.2. Course enrolment requirements		
Requirements for enrolment in the second year of study fulfilled.		
1.3. Expected learning outcomes		
1. Define the basic types of materials in electrical engineering and their characteristics 2. Analyze the structural structure of basic types of materials in electrical engineering 3. Evaluate basic mechanical, thermal, electrical and magnetic properties of engineering materials 4. Determine the connection between the state of processing, the structure and properties of the material 5. Compare basic applications of conductive, magnetic, insulating and semiconductor materials 6. Anticipate basic requirements when choosing materials used in electrotechnical products		
1.4. Course content		
Characteristics of the structural composition of crystals, amorphous solids, liquid crystals, polymers, ceramics and composites. Structure of metals and alloys. Electrical, magnetic, mechanical, thermal and technological properties of materials. Atomic processes in solid bodies. Materials for conductors and conductive elements: conductors in the narrower sense, resistors, thermocouples, thermobimetals, contacts, lines through glass, fuses. Magnetic materials: soft and hard ferromagnetic materials, ferrites. High frequency powder cores. Magnetic materials for magneto-optical memories. Magnetoelastic materials. Magnetostrictive alloys. Insulating materials and polarization. Inorganic, organic and complex insulators. Semiconductors and their application. Photovoltaic materials for converting sunlight into electricity: monocrystalline, polycrystalline, thin-layer crystalline and amorphous silicon, copper-indium-diselenide, cadmium telluride. Electrochemical systems and materials for electrical energy storage: lead-acid, NiCd, NiMH, Li-ion, Me-air, NaS and NaNiCl batteries, redox flow battery and hybrid flow battery. Electrical energy storage systems: ultracapacitor (DCL) and superconducting magnetic coil (SMES). Fiber optic technology and materials. Overview of technological procedures for processing materials and their impact on properties.		
1.5. Types of classes	☒ lectures	☐ individual exercises

	☐ seminars and workshops ☒ auditory exercises ☒distance learning ☐ field work	☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE),	2	1, 2, 3, 4, 5, 6	Lectures (L), laboratory exercises (LE), auditory exercises (AE),	Attendance tracking. Minimum attendance percentage: 70%.	4	8
Problem-solving exercises	1	2, 3,5, 6	Revision exams (written exam)	Evaluation	15	30
Preparation for laboratory exercises (LE), results analysis, report writing	0.8	1, 2, 3	Laboratory exercises (LE)	Preparation test for LE, LE supervision, LE report assessment	15	30
Preparing for an oral exam and oral exam	1	1, 2, 3, 4, 5, 6	Oral exam	Evaluation	15	30
Seminar paper	0.2	1, 2, 3, 4, 5, 6	Seminar paper	Oral presentation in class	0	2

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Filetin, T ; Kovačiček, F; Indof, J. Svojstva i primjena materijala Zagreb: Fakultet strojarstva i brodogradnje, 2009.
2. Advanced Electrical and Electronics Materials: Processes and Applications: K. M. Gupta, Nishu Gupta, Ashutosh Tiwari, Wiley, 2015.
2. Callister, W. D.; Rethwisch, D. G. Fundamentals of Materials Science and Engineering: An Integrated Approach New York: John Wiley & Sons, 2012.
3. V. Knapp, P. Colić Uvod u električna i magnetska svojstva materijala Školska knjiga Zagreb, 1990.
4. V. Bek Tehnologija elektromaterijala skripta ETF u Zagrebu, Sveučilišna naklada, Zagreb, 1989.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. Kalpakjian, S. Manufacturing Engineering and Technology Upper Saddle River NJ, Prentice Hall, 2000,
2. R. M. Brick i dr. Structure and Properties of Engineering Materials McGraw Hill, 1977.
4. T. Filetin Materijali i tehnologijski razvoj Akademija tehničkih znanosti Hrvatske, Zagreb, 2002.
5. Solymar, L. Walsh, D. Electrical Properties Of Materials OUP, 1998.

6. T. Fischer Materials Science for Engineering Students Elsevier, London, 2009. 7. 7 W. D. Callister Materials science and engineering: an introduction John Wiley & Sons, 2000.
8. Pintarić Materijali u elektrotehnici - laboratorijske vježbe ETF, Osijek, 2007.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Filetin, T ; Kovačiček, F; Indof, J. Svojstva i primjena materijala Zagreb: Fakultet strojarstva i brodogradnje, 2009.	5	60
Advanced Electrical and Electronics Materials: Processes and Applications: K. M. Gupta, Nishu Gupta, Ashutosh Tiwari, Wiley, 2015.	5	60
Callister, W. D.; Rethwisch, D. G. Fundamentals of Materials Science and Engineering: An Integrated Approach New York: John Wiley & Sons, 2012.	5	60
Callister, W. D.; Rethwisch, D. G. Fundamentals of Materials Science and Engineering: An Integrated Approach New York: John Wiley & Sons, 2012.	5	60
V. Bek Tehnologija elektromaterijala skripta ETF u Zagrebu, Sveučilišna naklada, Zagreb, 1989.	5	60

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Kruno Miličević, PhD, Full Professor, Vanja Mandrić, PhD, Associate Professor	
Course title	Basics of Electrical Signals Measurements	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Information and Communication Technology	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	7
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(45+(15+30+0)+0)

1. COURSE DESCRIPTION

1.1. Course objectives

Present the theoretical basis of metrology, measuring devices, and methods to students through lectures. Demonstrate examples of calculating measurement uncertainty and other data relevant to the measurement process through classroom exercises. Provide students with hands-on experience with measuring instruments through laboratory exercises. Present topics with an emphasis on applications in communication systems.

1.2. Course enrolment requirements

Requirements for enrolment in the second year of study fulfilled.

1.3. Expected learning outcomes

1. Understand and interrelate the basic concepts in metrology, and evaluate their significance in engineering practice.
2. Assess measurement uncertainty, as well as systematic and random errors.
3. Analyze the principles of operation of analog and digital measuring instruments and evaluate their impact on measurement uncertainty.
4. Select the optimal measurement method and conduct measurements of electrical quantities and signals in a safe manner, adhering to occupational safety regulations.
5. Evaluate measuring transducers and methods for measuring non-electrical physical quantities.
6. Assess the role of software and hardware in the measurement of physical quantities and signals in communication systems.

1.4. Course content

Basic concepts in metrology. Measurement unity, metrological pyramid, traceability. International System of Units. Ratio units. Errors. Measurement uncertainty. Complete measurement result. Decision making based on the complete measurement result. Types of signals, their parameters, and representation in the time and frequency domains. Measuring equipment. Meters (analog electromechanical, analog electronic, digital). Digital multimeter. Oscilloscope, measuring probes. Spectrum analyzer. Network analyzer. Parts of a digital measuring device (measuring transducer, adapter, analog-to-digital converter, display). Measurement methods (deflection, null, comparative, substitution, differential, direct, indirect). Measurement of electrical quantities (current, voltage, frequency, phase shift, resistance, inductance, capacitance and loss factor, impedance and admittance, harmonic content of signals, signal-to-noise ratio, S-parameters of two-port networks). Software and hardware in measurements. Measuring transducers and microelectromechanical sensors. Computer-controlled measurement systems (automated measurements, overview of software packages for measurement automation).

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☐ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE),	2,2	1,2,3,4,5,6	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum	0	0

laboratory exercises (LE), design exercises (DE)				attendance percentage: 70%.		
Problem-solving exercises	1	2,3,5	Revision exams (written exam)	Evaluation	15	30
Preparation for laboratory exercises (LE), results analysis, report writing	2,1	2,3,4,5,6	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	15	30
Preparing for an oral exam and oral exam	1,5	1,2,3,4,5,6	Oral exam	Evaluation	15	30
Group tasks during lectures	0,2	2,3,4	Group tasks	Verification of solutions and discussion with students	0	10

1.10. Obligatory literature (at the time of submitting a study programme proposal)

3. Smith, R.C. Uncertainty Quantification, SIAM 2013
4. R. Malarić Instrumentation and measurement in electrical engineering, Brown Walker Press (April 20, 2011)
5. Bartolić, Juraj, Mikrovalna elektronika, Zagreb: Graphis, 2011
4. Z. Godec Iskazivanje mjernog rezultata, ETF Osijek, 1995
5. Z. Godec, D. Dorić Osnove mjerenja, laboratorijske vježbe, ETF Osijek, 1998

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. D. Vujević, B. Ferković Osnove elektrotehničkih mjerenja I i II
2. Branka Zovko-Cihlar, Šum u radiokomunikacijama, Zagreb: Školska knjiga, 1987
3. V. Bego Mjerenja u elektrotehnici
4. D. Karavidović Električna mjerenja I i II
5. Šantić Elektronička instrumentacija

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Smith, R.C. Uncertainty Quantification, SIAM 2013	2	30
R. Malarić Instrumentation and measurement in electrical engineering, Brown Walker Press (April 20, 2011)	2	30
Z. Godec Iskazivanje mjernog rezultata, ETF Osijek, 1995	2	30
Z. Godec, D. Dorić Osnove mjerenja, laboratorijske vježbe, ETF Osijek, 1998	10	30
Z. Godec, D. Dorić Električka mjerenja s laboratorijskim vježbama, ETF Osijek, 1998	10	30

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Goran Martinović, PhD, Full Professor	
Course title	Operating Systems	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Information and Communication Technology	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5.5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	45+(0+30+0)+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Understanding the mechanisms of operating systems. Advanced use of modern operating systems. Overview and basics of using programming tools for the development of more efficient system application programs, considering the possibilities provided by the operating system.		
1.2. Course enrolment requirements		
Requirements for enrolment in the second year of study fulfilled.		
1.3. Expected learning outcomes		
1. understand the principles, system and programming mechanisms of operating systems in actual computer systems 2. analyse and compare the applicability of the principles, mechanisms and algorithms on which the work of operating systems is based at the process and thread level, scheduling, inter-process communication, deadlock, input-output units, data storage and structuring, security and the platforms on which they are used 3. create more advanced system and application solutions in suitable programming environments and languages based on adopted principles, mechanisms and algorithms in operating systems 4. analyse, evaluate and plan the use of current operating systems of personal computers, mobile devices and computer systems in a broader sense according to the requirements of the environment and users 5. use current operating systems at an advanced user, administrative, system and programming level		
1.4. Course content		
Development and review of operating systems. System requirements on the operating system, system calls, APIs. Structure of operating systems. Processes and threads: properties, inter-process communication, scheduling. Deadlocks: deadlock detection and prevention algorithms. Memory management: sharing, virtual memory, paging, segmentation. Input-output units: properties, disks, system clock, user interface, network communication. File system: implementation methods, examples (FAT, NTFS, others). Introduction to system support of multiprocessor, multicomputer and distributed computer systems. Security of operating systems: encryption, user authorization, system attacks and protection mechanisms. Introduction to operating system design: programming tools, requirements for responsiveness, reliability and interface, performance evaluation. Overview of operating systems through examples: UNIX, Linux, Windows, mobile OSes (Android, iOS, Windows Phone).		
1.5. Types of classes	☒ lectures ☐ seminars and workshops ☐ auditory exercises	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises

	☐ distance learning ☐ field work	☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), laboratory exercises (LE)	2.5	1, 2, 3, 4, 5	Lectures (L), laboratory exercises (LE)	Attendance tracking. Minimum attendance percentage: 70%.	3	6
Writing preparations for LV, analysis of results, and report writing	1	2, 3, 4, 5	Laboratory exercises (LE)	Evaluation of preparation for LV, supervision of implementation of LV, verification of written reports	12	24
Preparation for the oral exam and oral exam	1	1, 2, 4	Oral exam	Evaluation	20	40
Written exam and LV colloquium	1	1, 2, 3	Written exam and LV colloquium	Evaluation	15	30

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Budin, L; Golub M; Jakobović, D; Jelenković, L. Operacijski sustavi. Zagreb: Element, 2011.
2. Tanenbaum, A.S. Modern Operating Systems (3rd Ed). Pearson, 3rd Ed., 2013.
3. S. Bjornander, C ++ Windows Programming, Packt Publishing, 2016.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. W. Stallings, Operating Systems, Internals and Design Principles, Pearson Education, 7th Ed., 2011.
2. S. Das, Your UNIX: The Ultimate Guide, McGraw-Hill Science, 2000.
3. C. Schroder, Linux Cookbook, O'Reilly, New York, 2004.
4. Microsoft Windows Team Staff, Microsoft Windows XP Professional Resource Kit, Microsoft Press, 2003.
5. C. Negus, C. Bresnahan, Linux Bible, John Wiley & Sons, 8th Ed., 2012.
6. J.M. Hart, Windows System Programming (3rd Ed.), Addison Wesley Professional, Boston, 2014.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
1. Budin, L; Golub M; Jakobović, D; Jelenković, L. Operacijski sustavi. Zagreb: Element, 2011.	10	90

2. Tanenbaum, A.S. Modern Operating Systems (3rd Ed). Pearson, 3rd Ed., 2013.	5	90
3. S. Bjornander, C ++ Windows Programming, Packt Publishing, 2016.	3	90

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Tomislav Matić (Sr.), PhD, Full Professor, Marijan Herceg, PhD, Associate Professor	
Course title	Analogue Electronics	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Information and Communication Technology	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	45+(15+15+0)+0

1. COURSE DESCRIPTION

1.1. Course objectives

Students will be introduced to the procedures of electronic circuit analysis in the small and large signal mode, the analysis of analog and basic digital circuits, and the synthesis of basic analog and basic digital circuits.

1.2. Course enrolment requirements

Requirements for enrolment in the second year of study fulfilled.

1.3. Expected learning outcomes

1. analyze electronic circuits in static and dynamic working conditions
2. design amplifiers with bipolar and unipolar transistors for the defined frequency and amplification range
3. integrating basic amplifier stages into cascade junctions
4. evaluate the stability of a negative feedback amplifier
5. design differential and instrumentation amplifiers
6. design operational amplifier-based circuits for the implementation of linear and nonlinear analog functions
7. evaluate analog-to-digital and digital-to-analog converters
8. analyze basic microelectronic analog circuits

1.4. Course content

Basics of electronic circuit analysis. Single-stage bipolar and unipolar transistor amplifiers. Setting and stabilization of a biasing point. Analysis of dynamic parameters in small signal mode and at low frequencies: current and voltage gain, input and output resistance. Large signal mode of operation. Power amplifiers: A, AB, B, C and D class. Multi-stage amplifiers. DC coupled amplifiers: cascade, differential amplifier. Feedback. Amplifier frequency characteristic and stability in the presence of negative feedback. Differential amplifier. Operational amplifier. Comparators – comparator with hysteresis (Schmitt's trigger). Impulse response and linear shaping. Wave-shape generators: oscillators and multivibrators. Analog switches. Analog bipolar and unipolar integrated circuits: constant current sources, reference voltage circuits, voltage level shifting stages,

and basic amplifiers (CE, CS). Analog microelectronic circuits design principles: amplifiers, comparators, filters, waveform generators. Circuits for digital/analog (D/A) and analog/digital (A/D) conversion.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE)	0.7	1,2,3,4,5,6,7,8	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	2	1,2,3,4,5	Revision exams (written exam)	Evaluation	20	40
Preparation for laboratory exercises (LE), results analysis, report writing	1	1,5,6,7,8	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	10	20
Preparing for an oral exam and oral exam	2.3	1,2,3,4,5,6,7,8	Oral exam	Evaluation	20	40

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. P. Biljanović Elektronički sklopovi
2. T. Švedek Poluvodičke komponente i osnovni sklopovi, Svezak I

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. A.S.Sedra, K.C.Smith Microelectronic Circuits, 3.Edition

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*

P. Biljanović Elektronički sklopovi	2	40
T. Švedek Poluvodičke komponente i osnovni sklopovi, Svezak I	2	40
1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences		
Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.		

General information		
Lead instructor(s)	Alfonzo Baumgartner, PhD, Associate Professor	
Course title	Algorithms and Data Structures	
Study programme	Undergraduate university study programme i in Electrical Engineering and Information Technology, branch: Information and Communication Technology	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	45+(15+15+0)+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
1.2. Course enrolment requirements		
There are no special requirements for enrolling in the course.		
1.3. Expected learning outcomes		
1. describe basic terms related to algorithms and data structures 2. use basic linear and non-linear data structures: linked list, queue, stack, tree, graph 3. use known and important efficient algorithms for sorting and searching 4. write new algorithms by using a pseudocode or flow diagram 5. evaluate algorithms by using the basics of computational complexity theory		
1.4. Course content		
Algorithm, representation, computer implementation. Algorithm complexity. Errors caused by numeric data representation in a digital computer. Complex data structures: list, tree, graph; computer implementation. Searching and sorting algorithms. Random number generation by uniform, exponential and normal distribution. Generator evaluation, statistical tests. Recursive algorithms. Recursion, computer implementation, resource allocation.		
1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☐ distance learning	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor

	☐ field work	☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	2,5	1,4,5	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	2	10
Problem-solving exercises	1	2,3,5	Revision exams (written exam)	Evaluation	15	30
Preparation for laboratory exercises (LE), results analysis, report writing	0,8	2,3,4	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	15	30
Preparing for an oral exam and oral exam	1,7	1,5	Oral exam	Evaluation	15	30

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Cormen, Thomas H.; Leiserson, Charles E.; Rivest, Ronald L.; Stein, Clifford (2009) [1990]. Introduction to Algorithms (3rd ed.). MIT Press and McGraw-Hill. ISBN 0-262-03384-4.

2. D. E. Knuth, The Art of Computer Programming, Vol. 1., Fundamental Algorithms, Addison-Wesley, Reading, MA, 1997.

3. D. E. Knuth, The Art of Computer Programming, Vol. 2., Seminumerical Algorithms, Addison-Wesley, Reading, MA, 1998.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences		
Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.		

General information		
Lead instructor(s)	Drago Žagar, PhD, Full Professor, Krešimir Grgić, PhD, Associate Professor	
Course title	Communication Networks	
Study programme	Undergraduate university study programme in Electrical Engineering and Communication Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	45+(15+15+0)+0

1. COURSE DESCRIPTION
1.1. Course objectives
- To acquaint students with the basic principles of operation and architecture of modern wired and wireless communication networks.
1.2. Course enrolment requirements
- Requirements for enrolment in the second year of study fulfilled.
1.3. Expected learning outcomes
1. analyze and differentiate different types of communication networks 2. distinguish between the physical and logical structure of modern wired and wireless communication networks 3. evaluate the protocol stack based on OSI and TCP/IP reference models in modern communication networks 4. compare and evaluate the properties, characteristics and implementation method of control, routing and communication protocols on the Internet 5. evaluate basic security requirements and quality of service requirements in modern communication networks 6. propose and apply software tools for understanding and analyzing the operation of communication protocols
1.4. Course content
Defining the communication network. Effectiveness of communication. Information and traffic characteristics of the network. Capacities and flows in the network. Communication network model. Design parameters of the network. Application of communication networks. Telecommunication network. Integrated digital communication network. Intelligent network. Signaling in the network. Physical structure of networks. Logical structure of networks. OSI reference model. TCP/IP reference model. Transmission media. Wireless communication. Mobile networks. Local networks. Industrial LANs and protocols. Telemetry networks and technologies. Ad Hoc networks. Internet network architecture. Network routing. Examples of communication networks. Network services. Quality of service QoS. Network security. Standardization of networks.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☐ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE)	1.7	1, 2, 3, 4, 5, 6	Lectures (L), auditory exercises (AE), laboratory exercises (LE)	Attendance tracking. Minimum attendance percentage: 70%.	1	4
Problem-solving exercises	1.2	2, 4, 5	Revision exams (written exam)	Evaluation	16	32
Preparation for laboratory exercises (LE), results analysis, report writing	1.3	2, 4, 6	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	12	24
Preparing for an oral exam and oral exam	1.5	1, 2, 3, 4, 5	Oral exam	Evaluation	15	30
Consultative	0.3	2, 3, 4	Consultative	Evaluation	6	10

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Bažant, A. et al.: .Osnovne arhitekture mreža. Zagreb: Element, 2014.
2. Tanenbaum, A.S. Wetherall, D.J. Computer Networks (5th edition). Boston: Prentice Hall, 2011.
3. V. Sinković, Informacijske mreže, Školska knjiga Zagreb, 1994.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*

Bažant, A. et al.: .Osnovne arhitekture mreža. Zagreb: Element, 2014.	5	110
Tanenbaum, A.S. Wetherall, D.J. Computer Networks (5th edition). Boston: Prentice Hall, 2011.	5	110
V. Sinković, Informacijske mreže, Školska knjiga Zagreb, 1994.	5	110
1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences		
Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.		

General information		
Lead instructor(s)	Radoslav Galić, PhD, Full Professor, Tomislav Rudec, PhD, Assistant Professor	
Course title	Probability and Statistics	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(30+(30+0+0)+0)

1. COURSE DESCRIPTION
1.1. Course objectives
Introduction to the basic concepts and methods for solving problems in probability and statistics. Based on what they have learned, students will be able to apply these methods to solve specific practical problems in their professional field.
1.2. Course enrolment requirements
Requirements for enrolment in the second year of study fulfilled.
1.3. Expected learning outcomes
1. Design a problem model using basic counting rules and fundamental concepts from combinatorics. 2. Construct a model for calculating probability problems using rules for calculating the probability of union and intersection of events, rules of conditional probability, the formula for total probability, and Bayes' formula. 3. Design an expression for calculating probability problems using concepts from the theory of random variables and vectors. 4. Create mathematical expressions using basic statistical formulas to analyze a given statistical data set and interpret them for the given practical example. 5. Design a model to solve parameter estimation problems in a given practical example. 6. Define and distinguish basic concepts of statistical tests and apply appropriate statistical tests to practical examples.
1.4. Course content
Basics of combinatorics. Algebra of events. Probability and properties. A random variable. Random distribution function. Discrete and continuous probability distributions (hypergeometric, binomial, Poisson, normal,

uniform, exponential, chi-square, student distribution). Numerical characteristics of the distribution. Two-dimensional probability distributions. Moments and correlation. Statistical set with parameters. Empirical two-dimensional distribution. Correlation and regression analysis. Concept of the sample and numerical characteristics of the sample. Estimation of parameters.
Evaluation of intervals. Statistical hypothesis testing. Examples of statistical models, statistical inference, and applications of ready-made statistical programs.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☒ individual exercises ☐ multimedia and network ☐ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	1.7	2.-6.	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	1.3	1.-6.	Revision exams (written exam)	Evaluation	20	40
Preparing for an oral exam and oral exam	1.5	2.-6.	Oral exam	Evaluation	25	50
Homework	0.5	2.-6.	Homework	Questions based on what was presented	0	10

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Galić, Radoslav, Vjerojatnost i statistika, Osijek, 2013.
2. Mongomery, D.C., Applied Statistics and Probability for engineers, USA:Wiley, 2014.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. Pavlić, Statistička teorija i primjena, Tehnička knjiga, Zagreb, 2000.

2. Pauše, Ž, Uvod u matematičku statistiku, Školska knjiga, Zagreb, 1995.

3. Pauše, Ž, Vjerojatnost i stohastički procesi, Školska knjiga, Zagreb, 2004.

4. Devore, J.L., Probability and statistics for engineering and the sciences, USA, Cengage Learning, 2016.

5. Akritas, M., Probability and statistics with R for engineers and scientists, USA, Pearson, 2016.

6. Walpole,R.W, Myers, R. H., Myers, S. L., Ye, K., Probability and statistics for engineers and scientists, USA, Prentice Hall, 2017.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Galić, Radoslav, Vjerojatnost i statistika, Osijek, 2013.	15	110
Mongomery, D.C., Applied Statistics and Probability for engineers, USA:Wiley, 2014	1	110

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Irena Galić, PhD, Associate Professor	
Course title	Signals and Systems	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	30+(15+15+0)+0

1. COURSE DESCRIPTION

1.1. Course objectives

Students acquire the knowledge necessary for analyzing and modeling signals and systems by mastering the subject.

1.2. Course enrolment requirements

Requirements for enrolment in the second year of study fulfilled.

1.3. Expected learning outcomes

1. Define and classify signals and systems and utilize concepts from signals and system theory.
2. Analytically solve and evaluate mathematical models of first and second-order continuous and discrete-time linear systems.
3. Model and evaluate dynamic systems in Simulink and program in MATLAB.

4. Define and describe the principle of superposition, superposition integral, superposition sum, convolution integral, and convolution sum.
5. Define Laplace and Z-transformations and apply and evaluate them in determining the response of linear time-invariant systems.
6. Interpret the four Fourier transforms (CTFS, CTFT, DTFS, DTFT) and their properties, and describe their applications.

1.4. Course content

Mathematical models of continuous-time (CT) and discrete-time (DT) signals and systems. Classification. Analysis of linear systems. Fourier transforms of CT and DT signals (FS, FT, DTFT, and DTFS). Frequency characteristics and filtering principles. Laplace and Z-transformations. Decomposition and realization of systems. Stability, controllability, and observability of systems. Sampling and signal reconstruction. Equivalence of CT and DT systems. Programs for system analysis and simulation.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☐ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	2	1	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	2
Problem-solving exercises	1	1, 2, 4, 5	Revision exams (written exam)	Evaluation	15	30
Preparation for laboratory exercises (LE), results analysis, report writing	1	1, 3	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	12	18
Preparing for an oral exam and oral exam	1	1, 2, 4, 5, 6	Oral exam	Evaluation	25	50

1.10. Obligatory literature (at the time of submitting a study programme proposal)
1. B. P. Lathi. Linear Systems and Signals. Oxford University Press, 2004; ISBN: 0-19-515833-4
1.11. Recommended additional literature (at the time of submitting a study programme proposal)
1. A.V.Oppenheim, A.S.Willsky, Signale und Systeme, Arbeitsheft, VCH, Verlagsgesellschaft, Weinheim, 1989 2. Gabel i Roberts, Signals and Linear Systems, 3/e, J. Willey, 1987. 3. H. Babić. Signali i sustavi, Zavodska skripta, ZESOI, Fakultet elektrotehnike i računarstva Zagreb, 1996.
1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences
Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Ivanka Ferčec, MA, Senior Lecturer, Yvonne Liermann-Zeljak, MA, Senior Lecturer	
Course title	Technical English I	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	2
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	15+(15+0+0)+0

1. COURSE DESCRIPTION
1.1. Course objectives
The course aims to acquaint students with simpler professional texts and to highlight the differences between general English and English for Specific Purposes (ESP), with a particular emphasis on differences in grammatical structures such as the specific application of verb tenses in the active voice, expressing cause and effect, and the use of passive sentence structures. Additionally, the course aims to teach new vocabulary related to the topics covered, expand existing communication patterns, and acquire new ones. Students will also learn how to write short texts based on given keywords in their field of study.
1.2. Course enrolment requirements
Requirements for enrolment in the second year of study fulfilled.
1.3. Expected learning outcomes
1. Analyse, interpret and translate simpler professional texts. 2. Distinguish and apply basic verb tenses in the active and passive voice.

3. Connect simpler sentences into more complex ones using relative pronouns and adverbs.
4. Describe and correctly interpret diagrams, schemes, images, and mathematical formulas in the fields of electrical engineering and information and communication technology.
5. Create shorter professional texts in the field of electrical engineering based on given keywords.
6. Choose and defend a position on argumentative topics.

1.4. Course content

Academic English. What is engineering? Atom. Materials in electrical engineering. The electric circuit. Tenses (form, use, adverbs of time). Making questions (yes-no questions, wh-questions). Adjectives and adverbs. The passive voice. Cause and effect discourse markers. Classification.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☒ individual exercises ☐ multimedia and network ☐ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L) and auditory exercises (AE)	0.7	1, 2, 3, 4, 5, 6	Lectures (L), auditory exercises (AE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	0.6	1, 2, 3, 4, 5, 6	Revision exams (written exam)	Evaluation of solved exercises	25	50
Preparing for an oral exam and oral exam	0.5	1, 2, 3, 4, 5, 6	Oral exam	Evaluation of given answers	20	40
Homework	0.1	1, 2, 3, 4, 5	Grammar exercises/Short essays on a given topic	Oral evaluation of solved exercises/Correcting written assignments	0	5
Active class participation	0.1	1, 2, 3, 4, 5, 6	Self-initiated class participation through explaining technical subject matter, participating in and leading thematic debates, and	Recording self-initiated class participation /evaluation of given answers.	0	5

			graphically presenting technical concepts.				

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Bartolić, Lj. Technical English in Electronics and Electrical Power Engineering. Zagreb: Školska knjiga, 1994.
2. Bošnjak Terzić, B. Study Technical English 1. Zagreb: Školska knjiga, 2009.
3. Smith H.C.R. English for Electrical Engineering in Higher Education Studies. Reading: Garnet Publishing Ltd., 2014.
4. McCarthy, M.; O'Dell, F. Academic Vocabulary in Use. Cambridge: Cambridge University Press, 2008.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. Murphy, R. English Grammar in Use. Cambridge: Cambridge University Press, 2019.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Bartolić, Lj. Technical English in Electronics and Electrical Power Engineering. Zagreb: Školska knjiga, 1994.	2	110
Bošnjak Terzić, B. Study Technical English 1, Zagreb: Školska knjiga, 2009.	2	110
Smith H.C.R. English for Electrical Engineering in Higher Education Studies. Reading: Garnet Publishing Ltd., 2014.	2	110
McCarthy, M.; O'Dell, F. Academic Vocabulary in Use. Cambridge: Cambridge University Press, 2008.	2	110

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Petar Kerže, MKin, Senior Lecturer	
Course title	Physical Education IV	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	1
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(0+(0+30+0)+0)

1. COURSE DESCRIPTION

1.1. Course objectives

The goal and tasks of physical and health culture derive from the goals and tasks of the general educational system, and from the goals and tasks of the physical and health education field. They also derive from the role that it the area has a possible and necessary influence on changes in the anthropological status of students. It continues performed within certain homogenized groups, and according to the different wishes of the students who express interest in certain sports

1.2. Course enrolment requirements

Requirements for enrolment in the study programme fulfilled

1.3. Expected learning outcomes

1. Follow the guidelines and instructions about physical exercise and its importance for maintaining health and the impact on raising the level of quality of life.

2. Expand knowledge of a specific sport that is included in the curriculum,

3. Perform simple set tasks independently and as a team

1.4. Course content

The curriculum contains elements of team sports such as: basketball, volleyball, futsal, handball, table tennis tennis, badminton, free exercise without weights and elements of swimming, sports gymnastics and athletics.

As part of the Physical Culture course, students are given the opportunity to participate in faculty teams at university competition. The university championship offers competitions in sports such as handball, futsal, football, basketball, volleyball, table tennis, swimming, chess, bowling, billiards, darts, cross country, 3x3 basketball and beach volleyball. In all the mentioned sports, a competition is held for male and female students.

1.5. Types of classes	☐ lectures ☐ seminars and workshops ☐ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at laboratory exercises (LE)	1	1, 2, 3	Laboratory exercises (LE)	Attendance tracking. Minimum	-	-

				attendance percentage: 70%.			

1.10. Obligatory literature (at the time of submitting a study programme proposal)

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1.11. Recommended additional literature (at the time of submitting a study programme proposal)

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1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Tomislav Barić, PhD, Full Professor	
Course title	Fundamentals of Electric Machines and Drives	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Electrical Engineering	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5.5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(45+(15+15+0)+0)

1. COURSE DESCRIPTION

1.1. Course objectives

To provide students with the competencies necessary for understanding, modelling and analyzing electrical machines and drives in steady states.

1.2. Course enrolment requirements

Requirements for enrolment in the second year of study fulfilled.

1.3. Expected learning outcomes

1. Understanding the principle of operation of basic types of electrical machines.
2. Understanding the construction of basic types of electrical machines.
3. Understanding stationary operating conditions of electrical machines
4. Measure and evaluate physical quantities and parameters of basic types of electrical machines.

5. Differentiate between the principles of operation, construction and type of control of small and special electrical machines.
6. Analyze and solve selected numerical examples of basic electrical machines and drives.
7. Understanding the static characteristic of the load of electric motor drives.
8. Measure and evaluate physical quantities and parameters of electric drives in a stationary state
9. Simulation modelling and analysis of electrical machines and drives.

1.4. Course content

Basics of electrical and mechanical energy conversion. Transformers, transformer construction. Transformer models. Kapp diagram. Losses and types of losses in a transformer. Three-phase transformers, autotransformers, measurement transformers. Rotary machines and models. DC machines. Alternating machines. Rotating magnetic field. Induced voltage and mechanical torque. Physical basis of operation of synchronous and asynchronous machines. Performances of synchronous and asynchronous machines. Single-phase machines. Small and special electrical machines. Transmission mechanisms. Static conditions of electric motor drives. Adaptation of electric drives to the operating mechanism and energy source. Basics of simulation modelling and analysis of electrical machines and drives.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	2.5	1,2,3,4,5,6,7,8,9	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	1.5	6	Revision exams (written exam)	Evaluation	25	50
Preparation for laboratory exercises (LE),	0.5	4, 8, 9	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	0	10

results analysis, report writing						
Preparing for an oral exam and oral exam	1	1,2,3,5,7	Oral exam	Evaluation	20	40

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Pyrhonen, Juha; Jokinen, Tapani; Hrabovcova, Valeria Design of Rotating Electrical Machines
2. Wolf, R. Osnove električnih strojeva
3. Krause, Paul C.; Wasynczuk, Oleg; D. Sudhoff, Scott, Analysis of Electric Machinery and Drive Systems
4. Jurković, B. Elektromotorni pogoni

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. Ivan Mandić, Veselko Tomljenović, Milica Pužar Sinkroni i asinkroni električni strojevi
2. Piotrovskij, L.M. Električni strojevi
3. Dolenc, A. i dr. Transformatori I i II, skripta
4. Bego, V. Mjerni transformatori
5. Irving M. Gottlieb Practical Transformer Handbook
6. Dolenc, A. i dr. Električni strojevi

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Wolf, R. Osnove električnih strojeva	22	60
Jurković, B. Elektromotorni pogoni	6	60
Pyrhonen, Juha; Jokinen, Tapani; Hrabovcova, Valeria Design of Rotating Electrical Machines	1	60
Krause, Paul C.; Wasynczuk, Oleg; D. Sudhoff, Scott, Analysis of Electric Machinery and Drive Systems	2	60

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Damir Šljivac, PhD, Full Professor	
Course title	Basics of Energy and Ecology	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Electrical Engineering	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5.5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(45+(15+15+0)+0)

1. COURSE DESCRIPTION

1.1. Course objectives

Familiarity with basic knowledge of energy: sources, forms of energy and their energy conversions, and ecology: the impact of energy conversions on the environment and climate change.

1.2. Course enrolment requirements

Requirements for enrolment in the second year of study fulfilled.

1.3. Expected learning outcomes

1. Evaluate the basic physical and socio-political terms related to energy, basic sources and forms of energy.
2. Evaluate the basic energy and ecological features of renewable and non-renewable energy sources.
3. Identify and interpret the basics of the characteristics of electricity and the power system.
4. Apply theoretical knowledge in the field of renewable and non-renewable energy sources to analytically set problems in auditory exercises
5. Demonstrate the knowledge gained from the lectures and auditory exercises on selected models of laboratory exercises: Seebeck and Peltier effect, energy conversions of wind and solar energy, and familiarization with the basics of power system.

1.4. Course content

Classification of sources and forms of energy, conversion of chemical and nuclear energy into internal heat energy, conversion of internal heat into mechanical energy, conversion of potential energy of water into mechanical energy, conversion of mechanical into electrical energy, direct conversion into electrical energy, conversion of electrical energy into other forms of energy. Non-renewable energy sources (coal, oil, gas, nuclear and geothermal) and their energy conversions. Renewable energy sources (hydropower, biomass, wind, solar radiation and others) and their energy conversions. The impact of energy conversions on the environment during extraction, conversion and use with an emphasis on direct environmental pollution and global climate change, energy balance and efficiency, environmental protection measures in power plants and other measures of sustainable energy development. Basic characteristics of electricity and the power system: generation, transmission and distribution of electrical energy, power system components.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☐ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max

Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	0,6	1., 2., 3., 4., 5.	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	7	10
Problem-solving exercises	1,4	4.	Revision exams (written exam)	Evaluation	12,5	25
Preparation for laboratory exercises (LE), results analysis, report writing	1	5.	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	7,5	15
Preparing for an oral exam and oral exam	2,5	1., 2., 3.	Oral exam	Evaluation	25	50

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. D. Šljivac, D. Topić Obnovljivi izvori električne energije, udžbenik Fakultet elektrotehnike, računarstva i informacijskih tehnologija Osijek, 2018.
2. L. Jozsa Energetski procesi i elektrane, udžbenik Elektrotehnički fakultet Osijek 2006.
3. B. Udovičić Energetika, Školska knjiga Zagreb, 1993
4. B. Udovičić: Elektroenergetski sustav, Kigen, Zagreb, 2005.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. D. Feretić: Elektrane i okoliš, Sveučilište u Zagrebu, 2009.
2. Silvio de Oliveira Jr.: Exergy: Production, Cost and Renewability, Springer 2012
3. P. K. Nag: Power Plant Engineering, 4 th edition, McGraw-Hill Education, 2014.
4. V. Knapp: Novi izvori energije - nuklearna energija fisije i fuzije

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
1. D. Šljivac, D. Topić Obnovljivi izvori električne energije, udžbenik Fakultet elektrotehnike, računarstva i informacijskih tehnologija Osijek, 2018.	100	60
2. L. Jozsa Energetski procesi i elektrane, udžbenik Elektrotehnički fakultet Osijek 2006.	50	60
3. B. Udovičić Energetika, Školska knjiga Zagreb, 1993	10	60
4. B. Udovičić: Elektroenergetski sustav, Kigen, Zagreb, 2005.	10	60

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Davor Vinko, PhD, Associate Professor, Tomislav Matić (Sr.), PhD, Full Professor	
Course title	Digital and Pulse Circuits	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Information and Communication Technology	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(30+(15+15+0)+0)

1. COURSE DESCRIPTION		
1.1. Course objectives		
Students learn the methods of analysing and synthesising digital logic and sequential circuits as well as the methodology of designing basic and more complex microelectronic digital and pulse circuits.		
1.2. Course enrolment requirements		
Requirements for enrolment in the second year of study fulfilled.		
1.3. Expected learning outcomes		
1. Design of combinational and sequential digital circuits. 2. Application of Boolean algebra as a formal apparatus for the description of combinatorial and sequential digital circuits. 3. Recommendation of bistable, monostable and astable circuits. 4. Evaluate the work of bistable, monostable and astable systems. 5. Determine the functional principle of basic logic circuits. 6. Define the technological principles for the realization of microelectronic digital circuits 7. Analyze basic microelectronic digital and logic circuits		
1.4. Course content		
Digital bipolar and unipolar integrated circuits: Current switch, basic circuit of RTL, TTL, NMOS, CMOS family. Technology for the production of integrated circuits: Planar technology on silicon. Integrated design of basic logic circuits, calculation of voltage and current levels, delay time, operating speed. Status table. More complex logic and combination circuits, determination of fan-out and fan-in factors, their influence on the operation of the logic circuit. Minimization of logic functions. Design of basic sequential circuits: Latch, bistable, monostable, astable. CMOS implementation of latch and bistable. Triggering on state and triggering on edge. Analysis of bistable operation: SR, JK, T. Master-slave circuits. State diagram. CMOS version of the counter. Ring counters and ring oscillators. Basic types of memory cells. Read-out amplifiers. The influence of transmission lines on the operation of digital circuits. Design techniques for integrated circuits: ASIC. Principles of designing complex microelectronic digital circuits: A/D and D/A converters, Schmitt trigger circuit, filters, waveform generators, memory. Working with a software package for the design of integrated circuits.		
1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor

	☐ field work	☐ other _____
1.6. Comments		
1.7. Student obligations		
Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.		
1.8. Monitoring and assessment of student work		
Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.		
1.9. Assessment and evaluation of student work during classes and in the final exam		

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	0.5	1,2,3,4,5,6,7	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	1.5	1,2,6,7	Revision exams (written exam)	Evaluation	20	40
Preparation for laboratory exercises (LE), results analysis, report writing	1	4,5,6,7	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	10	20
Preparing for an oral exam and oral exam	2	1,2,3,4,5,6,7	Oral exam	Evaluation	20	40

1.10. Obligatory literature (at the time of submitting a study programme proposal)
1. U. Peruško, Digitalna elektronika
1.11. Recommended additional literature (at the time of submitting a study programme proposal)
1. T. Švedek, Osnove mikroelektronike
1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
U. Peruško, Digitalna elektronika	1	30

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Drago Žagar, PhD, Full Professor, Višnja Križanović, PhD, Assistant Professor	
Course title	Information Theory	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Information and Communication Technology	
Course status	Compulsory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures (+ auditory exercises + laboratory exercises + design exercises) + seminars)	(45+(15+15+0)+0)

1. COURSE DESCRIPTION		
1.1. Course objectives		
Acquiring knowledge and skills appropriate for evaluating the performance of information and communication systems that enable work in a digital environment. Train students to recognize different methods for searching and evaluating information and for evaluating the performance of existing information and communication systems.		
1.2. Course enrolment requirements		
Requirements for enrolment in the second year of study fulfilled.		
1.3. Expected learning outcomes		
1. Choose basic and advanced methods for searching and methods for evaluating information. 2. Valorise the basic parts of the information cycle. 3. Evaluate measures for probabilistic and informational description of the information and communication system. 4. To compare basic methods of entropy coding and methods of protective coding of information. 5. Evaluate the basic properties of information and communication systems. 6. To compare the application of basic modulation procedures on the information signal in information and communication systems.		
1.4. Course content		
Access to information using Internet services and their evaluation. Defining the term, nature and layers of information. The concept of entropy and its properties. Probabilistic description of the information system. Informational description of the communication channel. Information measures - concept, meaning, relations and properties. Communication channel capacity - fundamental theorem of channels with interference. Binary symmetrical channel. Model of the communication system. Information sources and information transfer. Theory of information and information network. Information flows and information network properties. Data processing in the information network. Basics of entropy coding of information. Basics of information security coding. Signal and noise characteristics. Continuous channels with noise. Basics of signal sampling and sample quantization.		
1.5. Types of classes	☒ lectures	☐ individual exercises

	☐ seminars and workshops ☒ auditory exercises ☒distance learning ☐field work	☐ multimedia and network ☒ laboratory exercises ☐design exercises ☐working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.:
Students' obligations include attending lectures, auditory exercises and laboratory exercises (in the amount of minimum 70% of class attendance), writing preparations for the laboratory exercises, analysing the results of the laboratory exercises, writing reports from laboratory exercises, solving the project task, solving tasks of the calculation type (on the control tasks or written exam), preparing for the oral exam and answering questions (on the control tasks or the oral exam).

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.:

Evaluation of the adoption of learning outcomes is carried out through control tasks, project tasks, performance of laboratory exercises and written and oral exams. The project task includes the evaluation of a solution to a given problem. Control tasks include tasks of the calculation type (in which the required solution is reached by a mathematical procedure), and tasks of the text type to check the acquisition of theoretical knowledge and assumptions (essay-type questions, tasks with circling one or more correct answers, tasks with completion, tasks with connection and similar).

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENTMETHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	1.5	1-6	Lectures (L), Auditory exercises (AE), Laboratory exercises (LE)	Attendance tracking. Minimum attendance percentage: 70%.	1	3
Problem-solving exercises	1.3	1-6	Revision exams (written exam)	Evaluation	16	32
Preparation for laboratory exercises (LE), results analysis, report writing	1	2-6	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	10	20
Solving project task	1	1	Project task	Evaluating a solution to a given problem	8	15
Preparing for an oral exam and oral exam	1.2	1-6	Oral exam	Evaluation	15	30

1.10. Obligatory literature (at the time of submitting a study programme proposal)
I. S. Pandžić i dr.: „Uvod u teoriju informacije i kodiranje”, Element, Zagreb, 2007. V. Sinković: „Informacijske mreže”, Školska knjiga, Zagreb, 1994. V. Sinković: „Informacija, simbolika i semantika”, Školska knjiga, Zagreb, 1997.
1.11. Recommended additional literature (at the time of submitting a study programme proposal)
V. Sinković: „Teorija informacija”, Školska knjiga, Zagreb, 1990. N. Rožić: „Informacija i komunikacije, kodiranje s primjenama”, Alinea, Zagreb 1992. C. L. Bovee, J. V. Thill: „Poslovna komunikacija suvremena ”, Pearson, 2012. T. M. Cover, J. A. Thomas: „Elements of Information Theory”, Wiley, New Jersey, 2006. R. B. Ash: „Information Theory”, Dover Publications, 1990.
1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
I. S. Pandžić i dr.: „Uvod u teoriju informacije i kodiranje”, Element, Zagreb, 2007.	5	30
Vjekoslav Sinković: „Informacijske mreže”, Školska knjiga, Zagreb, 1994.	5	30
Vjekoslav Sinković: „Informacija, simbolika i semantika”, Školska knjiga, Zagreb, 1997.	5	30

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences
Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Ivanka Ferčec, MA, Senior Lecturer, Yvonne Liermann-Zeljak, MA, Senior Lecturer	
Course title	Technical English II	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	2
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	30+(15+0+0)+0

1. COURSE DESCRIPTION
1.1. Course objectives
The aim of the course is to acquire and expand vocabulary related to professional topics in the fields of electrical engineering and information and communication technology, and to apply it in oral and written communication. The course expands knowledge of grammatical and language structures characteristic of use in specialised contexts. Furthermore, the course aims to make students aware of the importance of

communication and presentation skills for their future work environments and to familiarise them with phrases used in delivering oral presentations in English.

1.2. Course enrolment requirements

Requirements for enrolment in the third year of study fulfilled.

1.3. Expected learning outcomes

1. Analyse and interpret complex professional texts.
2. Apply more advanced professional terminology in written and oral communication.
3. Critically reflect on a professional topic in written and oral form.
4. Distinguish and apply active and passive grammatical structures in written and oral communication.
5. Correctly use verb patterns when writing professional texts.
6. Orally present a given/chosen professional topic within the allotted time.

1.4. Course content

Branch *Electrical Engineering*
Transistors. How transistors work. Measuring instruments. Resistors. Diodes. Electrical machinery. Inside an electric motor.

Branch *Information and Communication Technology*
Transistors. How transistors work. Computer architecture. Buying a computer. Telecommunications. A GSM network. 5G network. What's to fear about mobile phones? Networks. Bluetooth.

Oral presentations. Making questions (direct and indirect questions, question tags). Comparison and contrast discourse markers. Sequence words. The function of an item. Relative clauses. Reduced relative clauses. Conditional clauses. Subject-verb agreement.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☒ individual exercises ☐ multimedia and network ☐ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L) and auditory exercises (AE)	0.5	1, 2, 3, 4, 5	Lectures (L), auditory exercises (AE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0

Problem-solving exercises	0.5	1, 2, 3, 4, 5	Revision exams (written exam)	Evaluation of solved exercises	20	40
Preparing for an oral exam and oral exam	0.4	1, 2, 3, 4	Oral exam	Evaluation of given answers	15	30
Oral presentation on a given/chosen professional topic	0.4	6	Oral presentation on a given/chosen professional topic	Evaluation of presentation performance according to predetermined criteria	10	20
Homework	0.1	1, 2, 3, 4, 5	Grammar exercises/Short essays on a given topic	Oral evaluation of solved exercises/Correcting written assignments	0	5
Active class participation	0.1	1, 2, 3, 4, 5	Self-initiated class participation through explaining technical subject matter, participating in and leading thematic debates, and graphically presenting technical concepts.	Recording self-initiated class participation /evaluation of given answers.	0	5

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Bošnjak Terzić, B. Study Technical English 1. Zagreb: Školska knjiga, 2009.
2. Smith H.C.R. English for Electrical Engineering in Higher Education Studies. Reading: Garnet Publishing Ltd., 2014.
3. Glendinning, E. H.; McEwan, J. Oxford English for Information Technology. Oxford: Oxford University Press, 2006.
4. Esteras, S.R. Infotech - English for Computer Users. Cambridge: Cambridge University Press, 2008.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. Ibbotson, M. Professional English in Use - *Engineering*. Cambridge: Cambridge University Press, 2009.
2. Murphy, R. English Grammar in Use. Cambridge: Cambridge University Press, 2019.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Bošnjak Terzić, B. Study Technical English 1, Zagreb: Školska knjiga, 2008.	5	80
Smith H.C.R. English for Electrical Engineering in Higher Education Studies. Reading: Garnet Publishing Ltd., 2014.	5	80
Glendinning, E. H.; McEwan, J. Oxford English for Information Technology. Oxford: Oxford University Press, 2006.	5	80
Esteras, S.R. Infotech - English for Computer Users. Cambridge: Cambridge University Press, 2008.	5	80

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Krešimir Fekete, PhD, Associate Professor	
Course title	Basics of Power Systems	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Electrical Engineering	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	45+15+15+0+0

1. COURSE DESCRIPTION
1.1. Course objectives
Familiarize students with the function and basic features of the power system as well as with the purpose and topology of the electric power network. Train students to properly choose suitable equivalent models for the basic elements of the electric power network: generator, transformer, and transmission line. Empower students to perform current and voltage calculations in different situations in simple example of electric power networks.
1.2. Course enrolment requirements
Requirements for enrolment in the third year of study fulfilled.
1.3. Expected learning outcomes
1. Define the power system and electric power network and describe their main features and parts 2. Evaluate the current-voltage relationships in symmetrical and asymmetrical three-phase systems. 3. Identify the electrical parameters of the main elements of the electrical power network: generators, transformers, transmission lines, and consumers and synthesize them into equivalent circuits 4. Evaluate the transmission line inductance and capacitance calculation using the sgu method 5. Compare and evaluate mathematical models for short, medium and long transmission lines 6. Evaluate the calculation of currents and voltages in the electric power network using equivalent models for basic elements 7. Measure THE electrical quantities for different operating conditions of transmission lines and transformers using the laboratory simulator of transmission lines and transformers
1.4. Course content
Introduction: Basic features of the electric power system: definition and function of the power system, historical development and future trends, and basic elements.

Electric power network: types, objectives, and operation of the electric power network, network elements, active and passive branches of the network, electrical power, three-phase network, and its single-phase equivalent. Unsymmetrical three-phase network -method of symmetrical components.
Generator: function, basic operating principle, electrical parameters, and equivalent model.
Transformer: function, basic operating principle, electrical parameters, and equivalent model.
Transmission line: function, basic operating principle, electrical parameters, and mathematical model for short, medium, and long transmission lines. Electrical parameters of transmission lines - calculation using the sgu method.
Calculation of currents and voltages in electrical power network: numerical quantities in calculations, method of absolute values, method of relative values

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	2	1, 2, 3, 4, 5, 6, 7	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	1	2, 3, 4, 5, 6	Revision exams (written exam)	Evaluation	20	40
Preparation for laboratory exercises (LE), results analysis, report writing	1.5	5, 7	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	5	10
Preparing for an oral exam and oral exam	1.5	1, 2, 3, 4, 5, 6	Oral exam	Evaluation	25	50

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. M. Ožegović i K. Ožegović: Električne energetske mreže I, II, III i IV, FESB Split i OPAL COMPUTING, 1997.
2. S. Nikolovski i D. Šljivac: Elektroenergetske mreže (zbirka zadataka), ETF Osijek, 2003.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)
1. T. Gonen: Electrical Power Transmission System Engineering Analysis and Design, CRC Press, 2014. 2. J. D. Glover, T. Overbye, M.S. Sarma: Power System Analysisi and Design, 6th Edition, Cengage Learning, 2017.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
M. Ožegović i K. Ožegović: Električne energetske mreže I, II, III i IV, FESB Split i OPAL COMPUTING, 1997.	20	50
S. Nikolovski i D. Šljivac: Elektroenergetske mreže (zbirka zadataka), ETF Osijek, 2003.	10	50

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Dražen Slišković, PhD, Full professor	
Course title	Basics of Automatic Control	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Electrical Engineering	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	45+15+15+0+0

1. COURSE DESCRIPTION

1.1. Course objectives

To acquire knowledge about the description of the dynamic system, the structural representation of the automatic control system, the feedback phenomenon and the stability analysis of the feedback system. To acquire basic knowledge about how to design a control algorithm and evaluate the achieved quality of control, as well as experience in working with a software tool for the analysis and synthesis of control systems.

1.2. Course enrolment requirements

Requirements for enrolment in the third year of study fulfilled.

1.3. Expected learning outcomes

1. build a mathematical model of a simple dynamic system
2. analyse dynamic behavior of a system in a time domain, complex variable domain and frequency domain
3. test of accuracy of control circuit/system and analyse its static properties
4. test the stability of a control loop/circuit by applying analytical and graph-analytical methods

5. design a simple control algorithm using grapho-analytical and analytical synthesis methods
6. carry out an analysis and synthesis of a control circuit/system using Matlab
7. explain the structure and realization of a digital control system

1.4. Course content

Automatic control and its purpose. Basic terms and definitions. Basic structure and elements of the control system. Implementation of a control system. Linearization of static characteristic. Dynamic behaviour of the system and its mathematical description. Description of linear, continuous and time invariant systems in time and frequency domain. Laplace transform and transfer function. Bode and Nyquist plot. Basic transfer/dynamic elements. Control circuit and its characteristics. Control loop/circuit stability and methods of stability analysis. Regulation quality indicators in time and frequency domain. Basic controller types. Control system synthesis. Fixed set-point control and servo control. Control circuit behaviour in regard to reference variable and disturbance. Classic methods of synthesis of linear continuous control systems. Synthesis in time and frequency domain. Empirical rules for setting the controller parameters. Improvement of dynamic properties of control systems by introducing feedforward and cascade control. Improvement of dynamic properties of control by introducing of additional control loops. Practical examples. Principles of digital implementation of control systems.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☐ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	2.5	1, 2, 3, 4, 5, 6, 7	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	2	6
Problem-solving exercises	1.2	1, 2, 3, 4, 5	Revision exams (written exam)	Evaluation	15	30
Preparation for laboratory exercises (LE), results analysis, report writing	1.1	2, 3, 4, 6, 7	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	10	24

Preparing for an oral exam and oral exam	1.2	2, 3, 4, 5, 7	Oral exam	Evaluation	20	40

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Perić, N.: Automatsko upravljanje - predavanja
2. Nyarko, E.K., R. Grbić, D. Slišković, R. Cupec: Osnove automatskog upravljanja – Priručnik za laboratorijske vježbe

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. Tomac, J.: Osnove automatske regulacije - predavanja
2. Šurina, T.: Automatska regulacija
3. Franklin, G.F., J.D. Powell, A.E. Naeini: Feedback Control of Dynamic Systems

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Perić, N.: Automatsko upravljanje - predavanja	50	50
Nyarko, E.K., R. Grbić, D. Slišković, R. Cupec: Osnove automatskog upravljanja – Priručnik za laboratorijske vježbe	50	50

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Denis Pelin, PhD, Full Professor	
Course title	Principles of Power Electronics	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Electrical Engineering	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(45+15+15+0+0)

1. COURSE DESCRIPTION

1.1. Course objectives

Mastering the basic knowledge of converter technique, which creates the basis for understanding the operation, testing and selection of components and the design of power electronics devices.

1.2. Course enrolment requirements

Requirements for enrolment in the hird year of study fulfilled.

1.3. Expected learning outcomes

1. Choose models of converter components for a sufficiently accurate and mathematically undemanding analysis.
2. Compare the properties and performance characteristics of individual types of converters.
3. Analyse the operation of DC/DC converters, rectifiers, inverters and bi-directional converters.
4. Evaluate the operation of DC/DC converters with or without galvanic isolation, rectifiers and inverters.
5. Measure and analyse electrical quantities on the example of a single-phase fully controllable H-bridge topology.
6. Analyse the influence of the commutation inductance of the mains transformer on the commutation of the current in a single-phase H-bridge rectifier.
7. Evaluate the feedback effects of the rectifier on the grid related to the load with reactive power and the injection of higher harmonic components of the current.

1.4. Course content

Basic terms, division and general properties of power electronic converters. Indicators of the quality of the conversion process. Power frequency distribution. The concept of a converter component. Constituent components and structure of the conversion circuit. Possible u-i characteristics of the converter component model. Realization of the converter component with one or more semiconductor power switches. Division and general properties of DC/DC converters. One-quadrant direct and indirect DC/DC converters. Multi-quadrant DC/DC converters. Reducing the switching stresses of converter components. Division and general properties of rectifiers. Uncontrolled and phase-controlled rectifiers. Bi-directional converters. Division and general properties of autonomous inverters. Autonomous single-phase and three-phase inverters with voltage input. Reduction of harmonics in the output current of the inverters.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☒ other team work
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	1,25	1,2,3,4,7	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	7	10
Problem-solving exercises	1,5	3,4,5,6	Revision exams (written exam)	Evaluation	12	24

Preparation for laboratory exercises (LE), results analysis, report writing	1,5	5,6,7	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	13	26
Converter topologies recognition checks	0,5	3,4	Team work	Evaluating a solution to a given problem	5	10
Preparing for an oral exam and oral exam	1,25	1,2,3,4,7	Oral exam	Evaluation	15	30

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Flegar, I. Elektronički energetski pretvarači
2. Ambrožič, V, Zajec, P. Električni servo pogoni
3. J.G. Kassakian, M.F.Schlecht, G.C.Verghese Osnove energetske elektronike-I dio; Topologije i funkcije pretvarača

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. N. Mohan, T.M. Undeland, W.P.Robbins: „Power Electronics“
2. B.Bose: „Power Electronic and Variable Frequency Drives:Technology and Applications“
3. I.Flegar: „Sklopovi energetske elektronike“

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Elektronički energetski pretvarači	10	50
Električni servo pogoni	5	50
Osnove energetske elektronike-I dio; Topologije i funkcije pretvarača	2	50

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Zvonimir Klaić, PhD, Associate Professor	
Course title	Electrical Installations and Lighting	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Electrical Engineering	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	4
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(30+(0+15+0)+0)

1. COURSE DESCRIPTION

1.1. Course objectives

Present the types of installations and types of protection in LV installations to the students, introduce them to the concept of smart installations. Present light technical parameters, light sources, internal and external lighting, and lighting control systems to the students.

1.2. Course enrolment requirements

Requirements for enrolment in the third year of study fulfilled.

1.3. Expected learning outcomes

1. classify grounding system of low-voltage installations, types of protection against electrical shocks in electrical installations (indirect and direct contact), parts and mode of operation of smart installation systems,
2. define basic light technical parameters, light sources regarding technology, characteristics of indoor and outdoor lighting and lighting control and monitoring systems,
3. create a project for managing a smart installation,
4. examine the safety of low-voltage installations.

1.4. Course content

Basic terms and names (types of electrical installations, designation of low-voltage network systems). Lightning protection installations. Effect of electric current on the human body. Protection against electrical shocks in electrical installations (indirect and direct contact). Low voltage lines and networks. Voltage drop on the supply line and selection of supply line with respect to the load.
Types of consumers and consumer loads. Overcurrent protective devices. Smart electrical installations. Basic lighting dimensions, lighting classes, lighting quality criteria and regulations. Indoor and outdoor lighting. Lighting control systems.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☐ auditory exercises ☒ distance learning ☐ field work	☒ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE),	1	1, 2, 3, 4	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	10

laboratory exercises (LE), design exercises (DE)						
Problem-solving exercises	1	1, 3	Revision exams (written exam)	Evaluation	10	20
Preparation for laboratory exercises (LE), results analysis, report writing	1	1, 3, 4	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	10	20
Preparing for an oral exam and oral exam	1	1, 2, 3, 4, 5, 6	Oral exam	Evaluation	25	50

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. N. Srb, Niskonaponske mreže i instalacije, Tehnička knjiga, Zagreb, 1991.
2. V. Srb, Kabelska tehnika, priručnik, Tehnička knjiga, Zagreb, 1970.
3. E. Širola, Cestovna rasvjeta, Grafika Hrašće, 1997.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. „The IESNA Lighting Handbook – References and Application“, 9. Izdanje, IESNA, New York, SAD 2000.

2. Ganslandt, R., Hofmann, H., „Handbook of Lighting Design“, ERCO Leuchten, GmbH, Germany, 1. Edition, 1992.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
N. Srb, Niskonaponske mreže i instalacije, Tehnička knjiga, Zagreb, 1991.	1	30
V. Srb, Kabelska tehnika, priručnik, Tehnička knjiga, Zagreb, 1970.	1	30
E. Širola, Cestovna rasvjeta, Grafika Hrašće, 1997	1	30

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Željko Hederić, PhD, Full Professor	
Course title	Electrical Machines and Drives Analysis	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Electrical Engineering	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(45+(15+15+0)+0)

1. COURSE DESCRIPTION

1.1. Course objectives

Mastering the elementary knowledge and skills in electrical machines measurements and analysis, that are needed for electrical drives analysis, model parameter identification and electric drive components selection and predictive maintenance.

1.2. Course enrolment requirements

Requirements for enrolment in the third year of study fulfilled.

1.3. Expected learning outcomes

1. Analyse the general characteristics of fundamental types of electrical machines and loads in standard drive types
2. Measure and evaluate the static and dynamic quantities in elementary electric drives
3. Identify physical models of mechanical part of electric drives
4. Analyse static and dynamic characteristics of elementary electric drives
5. Plan the predictive maintenance and testing of electric machines

1.4. Course content

General characteristics of elementary types of electrical machines and loads in drives. Static and dynamic characteristics of small and special electrical machines. Measurement of static and dynamic quantities in elementary electrical drives. Physical model identification and mathematical model derivation using Matlab. Analysis of system requirements for electrical drives and correct selection of electrical machine. Electric drive operation analysis. Fundamentals of industrial communication in electrical drives. Predictive maintenance planning and electric drives testing.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☒ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE),	2	1,2,3,4	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0

laboratory exercises (LE), design exercises (DE)						
Problem-solving exercises	1.5	1,4	Revision exams (written exam)	Evaluation	14	28
Preparation for laboratory exercises (LE), results analysis, report writing	1	2	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	10	20
Individual work	0.5	5	Tasks and instructions for individual exercises	Evaluation and presentation of individual exercises	6	12
Preparing for an oral exam and oral exam	1	1,2,3,4	Oral exam	Evaluation	20	40

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Jurković B., Elektromotorni pogoni
2. Mandić I., Pužar M., Sinkroni i asinkroni električni strojevi
3. Boldea I., Electric drives
4. Bose B. K. , Modern Power Electronics and AC Drives

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. Doncker R. Veltman A., Advanced Electrical Drives
2. Ambrožić V., Zajc P., Električni servo pogoni
3. Skalicki B., Grilec J., Električni strojevi i pogoni
4. Srb N., Elektromotori i elektromotorni pogoni s katalogom elektrotehničkih tvrtki

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Jurković B., Elektromotorni pogoni	5	50
Mandić I., Pužar M., Sinkroni i asinkroni električni strojevi	5	50
Skalicki B., Grilec J., Električni strojevi i pogoni	5	50
Modern Power Electronics and AC Drives	5	50
Srb N., Elektromotori i elektromotorni pogoni s katalogom elektrotehničkih tvrtki	5	50

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Dražen Bajer, PhD, Assistant Professor, Bruno Zorić, PhD, Assistant Professor	
Course title	Fundamentals of Object-Oriented Programming	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Information and Communication Technology	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	30 + 0 + 30 + 0 + 0

1. COURSE DESCRIPTION

1.1. Course objectives

Familiarise the students with the core concepts of the object-oriented software development paradigm. Enable students to recognize problem elements and disassemble the problems into parts appropriate for object-oriented modelling. Emphasise the importance of conjoining state and behaviour and implementation hiding through encapsulation and public interface exposure. Enable students to create simpler solutions to given problems by relying on existing code through the appropriate use of composition, inheritance and polymorphism. Give students the ability to handle errors and exceptions during program run-time. Provide students with skills to effectively utilise development environments, standard libraries and frameworks.

1.2. Course enrolment requirements

Requirements for enrolment in the third year of study fulfilled.

1.3. Expected learning outcomes

1. Define the core concepts of the object-oriented development paradigm
2. Discuss the appropriateness of applying different object-oriented elements or principles for a given problem
3. Model a solution to a problem respecting the rules of abstraction and encapsulation with an appropriate use of inheritance and polymorphism
4. Suggest an appropriate relationship between classes through composition or inheritance, depending on the requirements of a given problem
5. Apply an exception handling mechanism
6. Use an object-oriented programming language and the accompanying libraries in software development

1.4. Course content

Introduction to the object-oriented development paradigm. Abstraction and mapping from the real world to the object model. A class as the blueprint and an object as the realisation. Problem disassembly through class definition and relationship modelling. Encapsulation and providing public interfaces. Introducing dependencies on other objects through composition and aggregation. Inter-object communication. Creating class hierarchies through inheritance. Realising proper object behaviour through polymorphism. Exception and error handling in unforeseen circumstances during run-time. Introduction of commonly utilised libraries enabling easier and faster object-oriented software development.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☐ auditory exercises	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises

	☒ distance learning ☐ field work	☐ working with a supervisor ☐ other _____
1.6. Comments		
1.7. Student obligations		
Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.		
1.8. Monitoring and assessment of student work		
Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.		
1.9. Assessment and evaluation of student work during classes and in the final exam		

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	1	1,2,3,4,5,6	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	5
Problem-solving exercises	1,5	3,4,5,6	Revision exams (written exam)	Evaluation	17,5	35
Preparation for laboratory exercises (LE), results analysis, report writing	1,5	1,2,3,4,5,6	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	0	20
Preparing for oral exam and oral exam	1	1,2,3,4,5	Oral exam	Evaluation	20	40

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. M. Weisfeld, The Object-Oriented Thought Process, 5. izdanje, Pearson Education Inc., Boston, MA, SAD, 2019.
2. M. Lutz, Programming Python: Powerful Object-Oriented Programming, 5. izdanje, O'Reilly Media Inc., Sebastopol, CA, SAD, 2013.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. R. Wirfs-Brock, A. McKean, Object Design: Roles, Responsibilities and Collaborations, Pearson Education Inc., Boston, MA, SAD, 2003.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
M. Weisfeld, The Object-Oriented Thought Process, 5. izdanje, Pearson Education Inc., Boston, MA, SAD, 2019.	2	30
M. Lutz, Programming Python: Powerful Object-Oriented Programming, 5. izdanje, O'Reilly Media Inc., Sebastopol, CA, SAD, 2013.	2	30

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences
Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Davor Vinko, PhD, Associate Professor	
Course title	Basics of Microcontroller Systems	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Information and Communication Technology	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(15+(0+30+15)+0)

1. COURSE DESCRIPTION
1.1. Course objectives
To familiarize students with the architecture and operation of microcontrollers. To provide students with practical knowledge of working with AVR microcontrollers. To explain to students the process of designing a system based on a microcontroller and to show how to combine the program code and the circuit part into a functional unit.
1.2. Course enrolment requirements
Requirements for enrolment in the third year of study fulfilled.
1.3. Expected learning outcomes
Learning outcomes according to the set of learning outcomes 29. Application of digital instrumentation: 1. Determine the principle of operation of microcomputers. 2. Support the operation of microcomputers in the ATMEL Studio programming environment in assembler and C. 3. Assess the possibility of using microcomputers for measuring and recording physical quantities. 4. Evaluate the measured physical quantity on the microcomputer. Additional learning outcomes not defined by HKO: 5. Find and apply information from the technical specifications (e.g. data sheet) of the microcontroller. 6. Design a printed circuit board (PCB). 7. Integrate the C program code and the circuit part into a functional unit.
1.4. Course content
General information about microcontroller systems, the difference between a microcomputer and a microcontroller, RISC architecture, common solutions: AVR, PIC, STM, ARM. Programming languages and compilers used: Arduino, C++, BASCOM, ASSEMBLER, Atmel Studio. Design flow: writing code, compiling, setting fuse and lock bits, programming a hex file. Number systems. Characteristics of the C programming language when used in microcontrollers: working with pointers, bit operations, variables. Communication with microcontroller systems: UART, I2C, 1Wire. AVR microcontroller architecture, registers, input/output

interfaces: Current and voltage limits. Oscillators: internal RC, quartz. Analogue-to-digital conversion, timing circuits, comparator. Memory: Flash, EEPROM, SRAM. Working with interrupt routines, sleep modes, programming modes. Adding sensors and execution elements. Measurement of DC and AC quantities: voltage, current, power. Management of high-power loads (high and low frequency pulse width modulation - PWM), PCB design, assembly, testing. Project planning.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☐ auditory exercises ☒ distance learning ☐ field work	☒ individual exercises ☐ multimedia and network ☒ laboratory exercises ☒ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	0.5	1,2,3,4,5,6,7	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	1.5	2,4,5,6,7	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	10	20
Preparation for laboratory exercises (LE), results analysis, report writing	1	2,3,5,7	Design exercises (DE)	Solution evaluation	20	40
Preparing for an oral exam and oral exam	2	1,2,3,4,5,6,7	Oral exam	Evaluation	20	40

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Muhammad Ali Mazidi; Sarmad Naimi, Sepehr Naimi AVR Microcontroller and Embedded Systems: Using Assembly and C

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. Dhananjay V. Gadre, Nehil Malhotra tinyAVR Microcontroller Projects for the Evil Genius

2. John Catsoulis Designing Embedded Hardware

3. Atmel 8-bit AVR Microcontroller with 16K Bytes In-System Programmable Flash tehničke specifikacije

4. Richard H. Barnett, Larry O Cull, Sarah Cox Embedded C Programming and the Atmel AVR

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Muhammad Ali Mazidi; Sarmad Naimi, Sepehr Naimi AVR Microcontroller and Embedded Systems: Using Assembly and C	2	30

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Hrvoje Glavaš, PhD, Associate Professor	
Course title	Fundamentals of Power Engineering	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Information and Communication Technology	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	5
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	30+(15+15+0)+0

1. COURSE DESCRIPTION

1.1. Course objectives

The goal of the course is to introduce the student to the concept of energy through an overview of the historical development of knowledge of energy transformations. By defining the meaning of energy as a physical category, energy transformations are linked into a complete concept of energy balance. The energy balance should be presented as a way of approaching the troubleshooting of technical systems using practical examples from everyday use: microwave ovens, computers and washing machines. Building on the acquired knowledge is accompanied by the visualization of the balance using the Sanky diagram. Determine the most important consumption sectors on the example of the Sanky diagram of national energy needs. Analyze individual energy units through the share of renewable and non-renewable components. Divide non-renewable sources according to their representation in the balance sheet according to origin and analyze the ways of their conversion, energy power and availability of certain forms of reserves. The application of renewable energy sources should be analyzed through basic limitations, respecting the ecological component and the life cycle. By acquiring basic knowledge, you can finally look at the electric power system (EPS) with an emphasis on the communication and information infrastructure necessary for the optimal management of the EPS.

1.2. Course enrolment requirements

Requirements for enrolment in the study programme fulfilled.

1.3. Expected learning outcomes

1. Evaluate the basic physical and socio-political terms related to energy, basic sources and forms of energy.
2. Evaluate the basic energy and ecological features of renewable and non-renewable energy sources.
3. Identify and interpret the basics of the characteristics of electricity and the power system.
4. Apply theoretical knowledge from the field of renewable and non-renewable energy sources to analytically posed problems.

1.4. Course content

Energy, energetics, energy transformations and energy balance
Non-renewable energy sources, classification and reserves
Renewable energy sources, potentials and challenges of transformation
Electric power system, energy in buildings and traffic
Energy policy and environmental protection

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☐ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	0,25	1, 2, 3, 4	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	5	10
Problem-solving exercises	0,75	2, 4	Revision exams (written exam)	Evaluation	15	30
Preparing for an oral exam and oral exam	3	1, 2, 3, 4	Oral exam	Evaluation	30	60

1.10. Obligatory literature (at the time of submitting a study programme proposal)

B. Udovicic: Energetika, Školska knjiga, Zagreb, 1993.
H. Požar: Fundamentals of Energy 1, 2 and 3, Školska knjiga, Zagreb, 1992.

D. Šljivac, D. Topić: Renewable sources of electricity, FERIT, Osijek, 2018.
Enerpedia - wikiBasics of Energy (http://enerpedia.net)

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

D. Feretić et al.: Power plants and the environment, Element, Zagreb, 2000.
V. Knapp: New sources of energy - nuclear fission and fusion energy, Školska knjiga, 1993.
P. Kulišić: New sources of energy - solar energy and wind energy, Školska knjiga, 1991.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
B. Udovicic: Energetika, Školska knjiga, Zagreb, 1993.	10	30
H. Požar: Fundamentals of Energy 1, 2 and 3, Školska knjiga, Zagreb, 1992.	10	30
D. Šljivac, D. Topić: Renewable sources of electricity, FERIT, Osijek, 2018.	20	30

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Slavko Rupčić, PhD, Full Professor, Marina Skender, PhD, Assistant Professor	
Course title	Electromagnetic Fields and Waves	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Information and Communication Technology	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	7
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	45+(15+15+0)+0

1. COURSE DESCRIPTION

1.1. Course objectives

Familiarise students with the laws of electromagnetic field generation and the generation and propagation of electromagnetic waves. Introduce students to the methods used to analyse problems in electromagnetism.

1.2. Course enrolment requirements

Fulfilled requirements for enrolment in the study.

1.3. Expected learning outcomes

1. Determine the fundamental phenomena, quantities and laws of electromagnetic fields.
2. Evaluate Gauss's laws for electric and magnetic fields.
3. Evaluate Faraday's law of induction.
4. Apply Ampere-Maxwell's law.
5. Apply Maxwell's equations to derive the wave equation for electromagnetic waves.

6. Evaluate the laws of electromagnetism for simple physical situations.
7. Select the fundamental laws of electromagnetic theory for basic calculations magnitude of the electromagnetic field.
8. Select methods and techniques suitable for solving the problem of propagation of electromagnetic waves and radiation from electrically short antennas.
9. Recommend a mathematical formulation for simple cases of plane wave propagation and radiation from electrically short antennas.

1.4. Course content

Physical principles of electrical engineering in the presentation of field theory. Basic laws of electric and magnetic fields. Maxwell's equations. Boundary conditions. Poynting theorem and Poynting vector – energy balance of the EM field. Vectorial and scalar EM potentials. Electrostatic field. Bio-Savart's law, self-inductance and mutual induction. Introduction to the theory of EM waves. Plane wave: basic properties, reflection and refraction, propagation modes, energy density, power flow, polarisation. A plane wave in a dispersive medium, attenuated waves in a conductor. Propagation of EM waves in free space. Helmholtz equation. Elementary electric dipole.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments	Lessons can be held in English.	

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE)	1	1,2,3,4,5,6,7,8,9	Lectures (L), auditory exercises (AE), laboratory exercises (LE),	Attendance tracking. Minimum attendance percentage: 70%.	2	5
Problem-solving exercises	3.5	4,5,6,7,8,9	Revision exams (written exam)	Evaluation	23	45
Preparation for laboratory exercises (LE), results analysis, report writing	1.5	4,5,6,7,8,9	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	10	20
Preparing for an oral exam and oral exam	1	1,2,3,4,5,6,7,8,9	Oral exam	Evaluation	15	30

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Bartolić, J. Mikrovalna elektronika. Zagreb: Graphic, 2012.
2. Balanis, C. A. Advanced Engineering Electromagnetics, 2nd Edition. Wiley, 2012.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. E. C. Jordan, K. G. Balmain, Electromagnetic waves and radiating systems, Prentice-Hall, Inc. Englewood Cliffs, N.J, 1968.
2. R. F. Harrington, Time-harmonic electromagnetic fields, McGraw-Hill, New York, 1961.
3. J. Kraus, Electromagnetics, McGraw Hill, N.Y. 1984.
4. Z. Haznadar, Elektromagnetska teorija i polja, Liber, Zagreb, 1972.
5. E. Zentner, Radiokomunikacije, Školska knjiga, Zagreb, 1989.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Bartolić, J. Mikrovalna elektronika. Zagreb: Graphic, 2012.	1	15
Balanis, C. A. Advanced Engineering Electromagnetics, 2nd Edition. Wiley, 2012.	2	15

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Ivica Lukić, PhD, Associate Professor	
Course title	Databases	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	45+15+15+0+0

1. COURSE DESCRIPTION

1.1. Course objectives

The students will be presented the design of a business system from the real world to the database, using all phases of database development. Each phase of database development will be explained in detail, outlining the expected outcomes and specific challenges. Students will be shown data modelling using different models and the transformation from an entity-relationship model to a relational model. They will become familiar with relational algebra and SQL, acquiring skills for independently designing databases according to user requirements.

1.2. Course enrolment requirements

Requirements for enrolment in the study programme fulfilled

1.3. Expected learning outcomes

1. list the basic terms related to the database, and use the ER diagram to model the database
2. distinguish database models with an emphasis on the relational model, and build a relational database model from ER diagram
3. understand normal forms and sketch a normalized relational database schema using normal forms
4. create a database using SQL commands on different database management systems
5. evaluate and implement simple and complex SQL queries using relational algebra
6. create different solutions using SQL commands to ensure the security and integrity of the database and understand the connection between database integrity and business rules
7. organize work with transactions, create functions, stored procedures and views

1.4. Course content

Information system, business system model, database. Database management system. Development of information system. Development methods. Development phases. Data modelling. Conceptual data modelling. Entity-relationship models. Object models. Logical data modelling. Relational data model. Relational algebra. SQL language for working with relational databases. Integrity rules in the relational model. Data normalization. Network, hierarchical, and file models. Physical data modelling. Data management. Management functions. Computer-supported management.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☐ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	2.5	1, 2, 3, 4, 5, 6, 7	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	3	5
Problem-solving exercises	2	2, 3, 4, 5	Revision exams (written exam)	Evaluation	25	50
Preparation for laboratory exercises (LE), results	1	4, 5, 6, 7	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	8	15

analysis, report writing						
Preparing for an oral exam and oral exam	1.5	1, 2, 3, 5	Oral exam	Evaluation	15	30

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Hamilton, Bill . Programiranje SQL Server 2005. O'Reilly, 2006
2. Churcher, Clare . Beginning Database Design, 2nd Edition.New York, Apress, 2012.
3. D. Grundler, Primijenjeno računalstvo, Graphis, Zagreb, 2000.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. E. Codd, The Relational model for base Management, Addison Wesley, 1990.
2. L. Budin, Informatika za 1. razred gimnazije, Element, Zagreb, 1997.
3. J. Martin, Computer -base Organization, Prentice Hall, 1977.
4. M. Varga, Baze podataka, DRIP- Zagreb, 1994.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Hamilton, Bill . Programiranje SQL Server 2005. O'Reilly, 2006	Online	90
Churcher, Clare . Beginning Database Design, 2nd Edition.New York, Apress, 2012.	Online	90
M. Varga, Baze podataka, DRIP- Zagreb, 1994.	2	90

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Ivanka Ferčec, MA, Senior Lecturer, Yvonne Liermann-Zeljak, MA, Senior Lecturer	
Course title	Technical English III	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	2
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	15+15+0+0+0

1. COURSE DESCRIPTION

1.1. Course objectives

The aim of the course is to expand ESP vocabulary in the fields of electrical engineering (with an emphasis on power engineering) and information and communication technology, which students will be able to use in oral

and written communication. Students will also learn how to critically reflect on a professional topic in written and oral form and how to use paraphrasing techniques that involve more complex use of acquired grammatical and linguistic structures, with the goal of avoiding plagiarism.

1.2. Course enrolment requirements

Requirements for enrolment in the third year of study fulfilled.

1.3. Expected learning outcomes

1. Analyse and interpret complex professional texts.
2. Apply more complex professional terminology in written and oral communication.
3. Critically reflect on a professional topic in written and oral form.
4. Distinguish and apply active and passive grammatical structures in written and oral communication.
5. Correctly use verb patterns when writing professional texts.

1.4. Course content

Branch *Electrical Engineering*
Introduction to the energy business. Solar energy. Wind energy. Protecting the environment. The nuclear issue. The future of energy. Electric cars.

Branch *Information and Communication Technology*
Communications Systems: VoIP. Networking. Satellite communications. Drones. Artificial intelligence. Data security. Safe data transfer.

Phrasal verbs. Verb patterns. Prepositions (V/N/Adj + preposition, compound prepositions). Countable and uncountable nouns. Articles. Paraphrasing techniques.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☒ individual exercises ☐ multimedia and network ☐ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L) and auditory exercises (AE)	0.7	1, 2, 3, 4, 5	Lectures (L), auditory exercises (AE)	Attendance tracking. Minimum attendance percentage: 70%	0	0

Problem-solving exercises	0.6	1, 2, 3, 4, 5	Revision exams (written exam)	Evaluation of solved exercises	25	50
Preparing for an oral exam and oral exam	0.5	1, 2, 3, 4	Oral exam	Evaluation of given answers	20	40
Homework	0.1	1, 2, 3, 4, 5	Grammar exercises/Short essays on a given topic	Oral evaluation of solved exercises/Correcting written assignments	0	5
Active class participation	0.1	1, 2, 3, 4, 5	Self-initiated class participation through explaining technical subject matter, participating in and leading thematic debates, and graphically presenting technical concepts.	Recording self-initiated class participation /Evaluation of given answers	0	5

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Campbell, S. English for the Energy Industry. Oxford: Oxford University Press, 2009.
2. Smith H.C.R. English for Electrical Engineering in Higher Education Studies. Reading: Garnet Publishing Ltd., 2014.
3. Glendinning, E. H.; McEwan, J. Oxford English for Information Technology. Oxford: Oxford University Press, 2006.
4. Esteras, S.R. Infotech - English for Computer Users. Cambridge: Cambridge University Press, 2008.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. Murphy, R. English Grammar in Use. Cambridge: Cambridge University Press, 2019.
2. Thomson, A.J.; Martinet A.V.: A Practical English Grammar, Oxford University Press, 1986.
3. Ricca-McCarty, T.; Duckworth, M.: English for Telecoms and Information Technology, Oxford University Press, 2009.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Campbell, Simon (2009). English for the Energy Industry. Oxford: Oxford University Press.	2	80
Smith H.C.R. (2014) English for Electrical Engineering in Higher Education Studies. Reading: Garnet Publishing Ltd.	2	80
Glendinning, E. H.; McEwan, J. Oxford English for Information Technology. Oxford: Oxford University Press, 2006.	2	80
Esteras, S.R. Infotech - English for Computer Users. Cambridge: Cambridge University Press, 2008.	2	80

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Dominika Crnjac Milić, PhD, Full Professor	
Course title	Business Economics	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branches: Electrical Engineering, Information and Communication Technology	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	3
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	30+(15+0+0)+0

1. COURSE DESCRIPTION

1.1. Course objectives

To provide students with basic economic knowledge in the field of microeconomics.
To give students an understanding of how companies work, the benefits and problems of creating products and services and how they reach the customer or client.
Demonstrate to students the economic aspects of business performance of economic entities under market economy conditions.
Encourage students to adopt an entrepreneurial mindset.

1.2. Course enrolment requirements

Requirements for enrolment in the second year of study fulfilled.

1.3. Expected learning outcomes

1. use basic terms related to microeconomics
2. knowledge of the importance of individual functions in the company
3. define the concept of production and know how to interpret the production function
4. define the term depreciation, interest and interest account and their application
5. explain the concept of costs and types of costs
6. explain the concept of investment calculation and the purpose of investing in general
7. awareness of the importance of rational use of resources when creating products and services
8. recognition of the importance of research and development work, innovating products and services
9. explain the methods of dealing with business risks
10. explain the importance of the function of personnel selection and job design
11. explain the impact of digitization on business systems

1.4. Subject content

1. Theory of production (key parts of the production function, tasks, performance measures)
2. Types of production costs
3. Dynamics of costs and methods of cost separation
4. Cost price calculations
5. Economics of investments
6. Economics of procurement (tasks of economics of procurement, importance of price, price discounts, analysis of procurement costs, measures of procurement success)
7. Business logistics (special emphasis on e-logistics)
8. Sales economics (sales function, sales costs, sales success, deciding on sales methods)
9. Marketing (special emphasis on e-marketing)
10. Consumer behavior

11. Supply and demand
12. Economy of resources
13. Financial analysis and planning as a basis for financial decisions
14. Business risk management (concept of risk, dynamic and static risks, types of business risks, attitudes towards risk)
15. Function of personnel selection and workplace design
16. The role and application of accounting in the organizational structure
17. Business accounts (Financial reports of companies prescribed by the law of the Republic of Croatia)
18. Impact of digitization on business information systems
19. Economy of innovation
20. Research and development work as a prerequisite for successful business

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☐ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE)	1	1,2,3,4,5,6	Lectures (L), auditory exercises (AE)	Attendance tracking. Minimum attendance percentage: 70%.	0	10
Solving tasks	0,6	3,4,6	Control tasks (written exam)	Checking of solved tasks	15	30
Preparation for oral exam and oral responding to questions	0,6	1,2,3,4,5,6	Oral exam	Checking the given answers	15	30
Writing a seminar of work (team work)	0.4	1	Creating a seminar paper (team work)	According to the instructions for writing the seminar paper, the content and written expression of the written form are evaluated.	0	15

Creation of a ppt presentation and oral presentation of the topic of the seminar paper	0.4	1	Creating a digital ppt presentations, and presentation of the topic seminar work	Listening to the presentation during the lesson	0	15	

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. Karić, M., Ekonomika poduzeća, Ekonomski fakultet, Osijek, 2007.
2. Karić, M., Lacković, Z., Ekonomika elektrotehničkih poduzeća, Elektrotehnički fakultet u Osijeku, Osijek, 2003.
3. Samuelson P. A. , Nordhaus W. D. Ekonomija,19.izdanje, Mate d.o.o., Zagreb, 2011.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. Ravlić, P., Ekonomika poduzeća, Ekonomski fakultet, Zagreb, 1993.

2. A.Jelavić, P.Ravlić, A.Starčević, J.Šamanović, Ekonomika poduzeća, Ekonomski fakultet Zagreb, Sveučilište u Zagrebu, 1993

3. Pindyck, R.S., Rubinfeld, D. L., Mikroekonomija, Mate d.o.o., Zagreb, 2005.

4. Koutsoyiannis, A., Moderna Mikroekonomika, Mate d.o.o., Zagreb, 1996.

5. Gorupić, D. i D. Gorupić, Jr. (1990), Poduzeće, Informator, Zagreb, 1990.

6. Hamarić, S. i Sikavica, P., Ekonomika i organizacija poduzeća, Birotehnika, Zagreb, 1989.

7. Sikavica, P., Novak, M., Poslovna organizacija, Informator, Zagreb, 1993.

8. Karić, M., Mikroekonomika, Ekonomski fakultet, Osijek,2006.

9. Novak, B., Odlučivanje u financijskom upravljanju, Ekonomski fakultet u Osijeku, Osijek, 2002.

10. Crnković, L., Mesarić, J., Martinović, J., Organizacija i primjena računovodstva, Ekonomski fakultet u Osijeku, Osijek,2006.

11. Eraković A., Jurković M., Koprivčić Z., Mecner J., Mlikotin-Tomić D., Terek,D. Primjena zakona o trgovačkim društvima i zakona o sudskom registru, Zagreb, 1995.

12. Ž.Panian, K.Ćurko, Poslovni informacijski sustavi, Zagreb,2010.

13. P.Sikavica, F. Bahtijarević-Šiber, N. Pološki Vokić, Temelji menadžmenta, Zagreb,2008.

14. Ferenčak, I., Počela Ekonomike, Ekonomski fakultet, Osijek, 2003.

15. Štefanić, I., Inovativno poduzetništvo, Sveučilište Josipa Jurja Strossmayera u Osijeku, Osijek, 2015.

16. T.Ivančević, K.Perec, Osnove ekonomije, Visoka poslovna škola Zagreb, Zagreb, 2017.

http://www.vpsz.hr/media/files/Osnove_ekonomije.pdf

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Karić, M., Lacković, Z., Ekonomika elektrotehničkih poduzeća, Elektrotehnički fakultet u Osijeku, Osijek, 2003.	10	80
Samuelson P. A. , Nordhaus W. D. Ekonomija,19.izdanje, Mate d.o.o., Zagreb, 2011	1	80
Karić, M., Ekonomika poduzeća, Ekonomski fakultet, Osijek, 2007.	1	80

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information		
Lead instructor(s)	Krešimir Fekete, PhD, Associate Professor	
Course title	Power System Analysis	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Electrical Engineering	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	7
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	45+15+15+0+0

1. COURSE DESCRIPTION
1.1. Course objectives
To inform students of the basics of voltage regulation in radial and meshed networks. Capacitate students to independently choose the appropriate method for solving power flow calculations. Meet the students with the calculation of short circuits in power networks and train them to calculate short circuit currents numerically as well as using a computer.
1.2. Course enrolment requirements
Requirements for enrolment in the third year of study fulfilled.
1.3. Expected learning outcomes
1. Analyze and model the elements of the electric power network for voltage regulation calculations 2. Create a network model for power flow and fault calculations in the network 3. Identify and calculate network matrices, as well as admittance and impedance matrices 4. Assess voltage conditions and power flows in the power system 5. Select and evaluate mathematical procedures for calculating power flows depending on the network conditions 6. Calculate fault currents for different types of short circuits 7. Choose appropriate methods for short-circuit calculation depending on the type of fault and network conditions 8. Assess the security state of the power system
1.4. Course content
Voltage regulation in the network: Nominal voltage and deviations from the nominal voltage. Voltage changes over time. Voltage drop. Actions to maintain voltage in the network. Regulation of voltage magnitude and voltage angle. Maintenance of correct voltage regime. Performing voltage regulation on network elements with special reference to renewable energy sources. Reduction of reactive power in the network. Actions for reactive power compensation. Power flows in the network: Mathematical model of the electrical network. Equations for node powers and power flows. Classification of nodes. Calculation of power flows using the Gauss-Seidel and Newton-Raphson methods. Short circuit: Short circuit basics. Earthing of the three-phase network. Calculation of short-circuit current. Matrix method for calculation of short-circuit current applied on a computer. The role of renewable energy sources in the short-circuit calculation.

Analysis of power system stability.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	2.5	1, 2, 3, 4, 5, 6, 7, 8	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	0
Problem-solving exercises	1	3, 5, 6	Revision exams (written exam)	Evaluation	20	40
Preparation for laboratory exercises (LE), results analysis, report writing	1.5	1, 4, 6	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	5	10
Preparing for an oral exam and oral exam	1	1, 2, 5, 7	Oral exam	Evaluation	25	50

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. L. Jozsa Tokovi snaga u mreži, ETF Osijek
2. M. Ožegović i K. Ožegović Električne energetske mreže IV i V
3. S. Nikolovski i D. Šljivac Elektroenergetske mreže (zbirka zadataka)

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

Glover, J.D; Overbye, T; M.S.; Sarma Power System Analysis and Design, 6th Edition

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
L. Jozsa Tokovi snaga u mreži, ETF Osijek	10	40
M. Ožegović i K. Ožegović Električne energetske mreže IV i V	20	40
S. Nikolovski i D. Šljivac Elektroenergetske mreže (zbirka zadataka)	10	40

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Denis Vranješ, PhD, Assistant Professor	
Course title	Information and Communication Technologies in the Power Industry	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Electrical Engineering	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	(45+(0+30+0)+0)

1. COURSE DESCRIPTION

1.1. Course objectives

Familiarity with information communication systems in the power industry, technologies for communication within and between elements of the power system.

1.2. Course enrolment requirements

Fulfilled requirements for enrollment in the third year of study.

1.3. Expected learning outcomes

1. Identify the parts of the power system and their characteristics and describe the management structure in the power system
2. Compare the features of different communication systems.
3. Define communication technologies in power systems
4. Determine and analyze the basic properties of the IEC 61850 protocol.
5. Identify the features of communication technologies in power systems
6. Apply knowledge gained from lectures in laboratory exercises

1.4. Course content

Getting to know the elements of the electric power system and their characteristics, the management structure in the electric power system, communication within and between the elements of the electric power system, communication systems and protocols used in the areas of production, transmission and distribution of electric energy (IEC 61850), analyzing the monitoring and control system and data collection and storage, communication systems and protocols on the side of the end user of the power system (electric motors,

distributed sources, smart homes, electromobility...), communication technologies for advanced power systems.

1.5. Types of classes	☐ lectures ☐ seminars and workshops ☐ auditory exercises ☐ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☐ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	0,6	1.,2., 3., 4., 5., 6.,	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	7	10
Problem-solving exercises	-	-	Revision exams (written exam)	Evaluation		
Preparation for laboratory exercises (LE), results analysis, report writing	2,4	6	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	20	40
Preparing for an oral exam and oral exam	3	1, 2, 3, 4, 5	Oral exam	Evaluation	25	50

1.10. Obligatory literature (at the time of submitting a study programme proposal)

Edited by Richard Zurawski; Industrial Communication Technology Handbook, CRC Press, Taylof&Francis Group, 2015.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. M.Z. Oskorei, B. Mohammadi-Ivatloo; Integration of Renewable energy sources into the power grid through powerfactory, Springer 2021.
2. H. Golpira, A. Roman-Messina, H. Bevrani; Renewable integrated power system stability and control, Wiley IEEE-Press, 2021
3. K.S. Manoj, Power system automation, Notion Press 2021.

4. C.Dey, S.K.Sen; Industrial Automation technologies, CRC Press 2020

Edited by Richard Zurawski; Network Embedded Systems, CRC Press 2017

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Edited by Richard Zurawski; Industrial Communication Technology Handbook, CRC Press, Taylof&Francis Group, 2015.	1	60

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)	Ratko Grbić, PhD, Associate Professor, Mario Vranješ, PhD, Associate Professor	
Course title	Introduction to Machine Learning	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Information and Communication Technology	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	7
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	45+(0+15+15)+0

1. COURSE DESCRIPTION

1.1. Course objectives

Introduce students to the principles of data analysis and machine learning methods. Familiarize students with types of machine learning (supervised and unsupervised learning). Enable students to develop machine learning models for solving classification and regression problems. Enable students to develop solutions for data clustering and dimensionality reduction using unsupervised machine learning methods. Introduce students to the basics of neural networks and deep learning. Enable students to acquire relevant skills in working with software tools that enable data analysis and machine learning.

1.2. Course enrolment requirements

Requirements for enrolment in the third year of study fulfilled.

1.3. Expected learning outcomes

1. Define basic concepts and principles of machine learning.
2. Propose a machine learning model to solve a specific problem.
3. Develop custom software solutions using appropriate libraries with implemented machine learning methods and algorithms.
3. Evaluate the suitability of using a supervised learning method for a given problem.
4. Evaluate the suitability of using an unsupervised learning method for a given problem.
5. Evaluate different machine learning models and conclude which model is most suitable for the given problem.

1.4. Course content

Introduction to machine learning. Types of machine learning: supervised learning, unsupervised learning. Regression and classification methods (binary classification, multi-class classification). Model complexity. Model evaluation measures based on the confusion matrix (accuracy, precision, recall, sensitivity, F-score). Model selection. Data preparation. Various supervised learning methods/algorithms: linear regression, polynomial regression, support vector machines, decision trees, random forests. Data clustering, dimensionality reduction, and feature extraction. Basics of neural networks. Basics of deep learning. Applications of deep learning in image processing and computer vision. Working with software tools that support machine learning and deep learning.

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☐ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☒ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), laboratory exercises (LE), design exercises (DE)	2	1,2,3,4,5,6	Lectures (L), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	0	5
Preparation for laboratory exercises (LE), results analysis, report writing	1,5	2,3,4,5,6	Laboratory exercises (LE)	Preparation for LE, LE supervision, LE report assessment	15	25
Solving problems assigned in design exercises	1,5	2,3,4,5,6	Design exercises (DE)	Evaluation of the solution for the given problem	10	20
Preparing for an oral exam and oral exam	2	1,2,4,5,6	Oral exam	Evaluation	25	50

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. E. Alpaydin, Introduction to Machine Learning, MIT Press, 2014

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

1. S. Raschka, Python Machine Learning, 3rd Edition, Packt Publishing Ltd., 2019		
1.12. Number of obligatory literature copies in relation to the number of students currently taking the course		
Title	*Number of copies*	*Number of students*
Introduction to Machine Learning	2	30
1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences		
Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.		

General information		
Lead instructor(s)	Snježana Rimac-Drlje, PhD, Full Professor	
Course title	Communication Systems	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology, branch: Information and Communication Technology	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	6
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	45+(15+15+0)+0

1. COURSE DESCRIPTION
1.1. Course objectives
To acquaint students with temporal and spectral characteristics of signals in communication systems, the influence of noise on signal quality during transmission in the baseband and passband, as well as the basics of radio communications and broadband systems.
1.2. Course enrolment requirements
Requirements for enrolment in the third year of study fulfilled.
1.3. Expected learning outcomes
1. Differentiate between the elements of an electronic communication system 2. Predict the characteristics of the digital signal during transmission in the baseband and passband 3. Evaluate modulations from the aspect of noise resistance and spectrum efficiency 4. Determine the parameters that influence the transmission of information to different transmission media 5. Compare the features of different radio communication systems 6. Evaluate the parameters of the radio system that affect the realization and quality of the communication link between the transmitter and the receiver
1.4. Course content

Elements of the communication system. Spectral analysis of signals, autocorrelation, power/energy spectral density. Random processes. Sources of noise in communication systems, white Gaussian noise, narrowband noise. The principle of optimal detection of a modulated signal. Amplitude, frequency and phase modulation; analysis of discrete modulations (ASK, FSK, PSK and QAM) from the point of view of spectral efficiency and noise resistance. Characteristics of transmission lines (two-wire line and coaxial cable). Theoretical foundations of radio communication systems. Characteristics of selected antennas. Basic radio wave propagation models. Broadband systems: spread spectrum and application in UMTS; characteristics of OFDM signals and applications. Features of radio communication systems of various purposes (radio relay connections, satellite connections, mobile access networks, broadcasting networks).

1.5. Types of classes	☒ lectures ☐ seminars and workshops ☒ auditory exercises ☒ distance learning ☐ field work	☐ individual exercises ☐ multimedia and network ☒ laboratory exercises ☐ design exercises ☐ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.8. Monitoring and assessment of student work

Defined by the Student evaluation criteria of the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and paragraph 1.9.

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	Max
Attendance at lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	1,5	1,2,3,4,5,6	Lectures (L), auditory exercises (AE), laboratory exercises (LE), design exercises (DE)	Attendance tracking. Minimum attendance percentage: 70%.	3	5
Problem-solving exercises	1,5	2,3,4,6	Revision exams (written exam), homework, project	Evaluation	15	35
Preparation for laboratory exercises (LE), results analysis, report writing	1	2,3,4,6	Laboratory exercises (LE)	LE preparation evaluation, LE supervision, LE report assessment	4	10
Preparing for an oral exam and oral exam	2	1,2,3,4,5,6	Oral exam	Evaluation	25	50

1.10. Obligatory literature (at the time of submitting a study programme proposal)

1. H.Taub, D.L. Schilling: Principles of Communication Systems, MGraw-Hill Book Company, 3rd edition, 2008.
2. E. Zentner: Antene i radiosustavi, Graphis, Zagreb, 2001.

3. S. Rimac-Drlje, Komunikacijski sustavi, priručnik za laboratorijske vježbe (skripta)
1.11. Recommended additional literature (at the time of submitting a study programme proposal)
1. S. Haykin: Communication Systems, John Wiley & Sons, 5th edition, 2009 2. Molisch, A. F. Wireless Communications, 2nd edition John Wiley&Sons, 2010
1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
H.Taub, D.L. Schilling: Principles of Communication Systems, MGraw-Hill Book Company, 3rd edition, 2008.	2	30
E. Zentner: Antene i radiosustavi, Graphis, Zagreb, 2001.	2	30
S. Rimac-Drlje, Komunikacijski sustavi, priručnik za laboratorijske vježbe (skripta)	2	30

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences
Conducting a university survey on teachers (teacher availability during office hours, quality of teaching materials on course websites, clarity and comprehensibility of lectures, fairness and transparency in grading) and conducting a Faculty survey on learning outcomes and ECTS credits.

General information

Lead instructor(s)		
Course title	Final Paper	
Study programme	Undergraduate university study programme in Electrical Engineering and Information Technology	
Course status	Compulsory	
Year of study	3	
ECTS credits and teaching methods	ECTS credits	12
	Number of classes (lectures + auditory exercises + laboratory exercises + design exercises + seminars)	-

1. COURSE DESCRIPTION
1.1. Course objectives
Assign a task at the appropriate scientific and professional level for a student to demonstrate their engineering skills relevant to the practical problem. Supervise the student in completing the assigned task.
1.2. Course enrolment requirements
Requirements for enrolment in the third year of study fulfilled.
1.3. Expected learning outcomes
1. Analyse a given problem in the field of electrical engineering and information technology. 2. Evaluate the problem-solving methods. 3. Examine the problem-solving solutions. 4. Apply the adopted problem-solving learning outcomes. 5. Model, simulate or create a prototype for a given task. 6. Evaluate and document the obtained solution.

7. Compare the obtained solution with existing solutions of the same or similar problem by studying the literature.
8. Apply communication skills in writing the paper and presenting it in a linguistically and ethically appropriate manner.
9. Recommend possible guidelines for further development of the proposed solution using the principles of scientific work.

1.4. Course content

Depends on the topic of the Final Paper.

1.5. Types of classes	☐ lectures ☐ seminars and workshops ☐ auditory exercises ☐ distance learning ☐ field work	☒ individual exercises ☐ multimedia and network ☐ laboratory exercises ☐ design exercises ☒ working with a supervisor ☐ other _____
1.6. Comments		

1.7. Student obligations

Defined by the Ordinance on Final Papers and Master's Theses

1.8. Monitoring and assessment of student work

Defined by the Ordinance on Final Papers and Master's Theses

1.9. Assessment and evaluation of student work during classes and in the final exam

STUDENT ACTIVITY	ECTS	LEARNING OUTCOME	TEACHING METHOD	ASSESSMENT METHOD	POINTS	
					Min	max
Defined by the Ordinance on Final Papers and Master's Theses	12	-	-	-	-	-

1.10. Obligatory literature (at the time of submitting a study programme proposal)

Depends on the topic of the Final Paper.

1.11. Recommended additional literature (at the time of submitting a study programme proposal)

Depends on the topic of the Final Paper.

1.12. Number of obligatory literature copies in relation to the number of students currently taking the course

Title	*Number of copies*	*Number of students*
Depends on the topic of the Final Paper.	-	-

1.13. Quality assurance methods ensuring the acquisition of knowledge, skills and competences

Pursuant to the Ordinance on Final Papers and Master's Theses:
- the topic is approved by the Committee for Final Papers and Master's Theses;
- the paper is evaluated by an evaluator in addition to the supervisor.

5.4. Evaluation criteria

OKVIRI KRITERIJA OCJENJIVANJA STUDENATA FERIT-a

U Tablici 1 su prikazane moguće aktivnosti tijekom semestra, „pragovi", preporučeni udio pojedinačne aktivnosti u ukupnom broju bodova ostvarivih tijekom semestra i sl. Za svaki predmet potrebno je uz praćenje pohađanja nastave provoditi još najmanje dvije aktivnosti. Ako je za aktivnost potreban broj bodova/postotak naveden u obliku „od-do", nositelj predmeta za svoj predmet treba za tu aktivnost odrediti točno potreban broj bodova/postotak unutar tog raspona.

Ako studenti ne ostvare minimalno potreban uspjeh iz svih aktivnosti da bi se one smatrale uspješno položenim, tj. ako ne ostvare „pragove" iz svih aktivnosti, nemaju pravo prijaviti ispit, nego trebaju nadoknaditi aktivnost.

Ako student dobrovoljno želi neku aktivnost izvršavati ponovno sljedeće ak. godine, onda se podrazumijeva da niti jedna aktivnost na predmetu nije uspješno položena, tj. student mora ponovno polagati sve aktivnosti na predmetu. Studentu koji ponovno izvršava aktivnosti, predmetni nastavnik može u potpunosti ili djelomično priznati uspješno odrađene aktivnosti u prethodnoj godini (npr. uspješno pohađanje nastave ili bodove iz LV) te student ima pravo ponovno pristupiti kontrolnim zadaćama i u tom slučaju student je dužan na početku akademske godine nastavniku najaviti dolaske na kontrolne zadaće.

Ako je trajanje uspješno položene aktivnosti i/ili bodova vezano uz ispitni rok, onda to znači da je vezano za jedan ispitni termin u slučaju izvanrednih ispitnih rokova, odnosno za najviše oba ispitna termina redovitog ispitnog roka (zimski, ljetni, jesenski). Iznimno, ako se održava izvanredni ispitni rok u rujnu, onda uspješno položene aktivnosti i/ili bodovi u jesenskom roku obuhvaćaju i taj izvanredni ispitni rok.

Ukupan broj bodova (UBB) i konačna ocjena određuju se prema Tablici 2.

Za sve studente vrijede oni kriteriji koji su vrijedili pri prvom upisu predmeta. Ako student pri ponavljanju predmeta izvršava ponovno sve aktivnosti, tada za studenta vrijede oni kriteriji koji su definirani za ak. godini u kojoj student ponavlja predmet.

Studenti u statusu „dovršetka studija" po razini opterećenja jednaki su redovitim studentima, te se stoga na njih odnose sve odredbe na isti način kao i na redovite studente.

Pod terminom nastave smatra se razdoblje od najmanje jednog školskog sata istog oblika nastave iz istog predmeta tijekom kojeg nastavnik evidentira nazočnost studenata.

Studentu koji ometa izvođenje nastave nastavnika i/ili praćenje nastave ostalih studenata, odnosno izvođenje provjere znanja, nastavnik ima pravo poništiti evidentiranu nazočnost u dotičnom terminu, odnosno evidentirati za termin neopravdani izostanak, te ga uputiti da napusti prostoriju. Usto prema sveučilišnom „Pravilniku o stegovnoj odgovornosti studenata" nastavnik ima pravo studenta prijaviti za ometanje izvođenja nastave ili provjere znanja, odnosno za nedolično ponašanje prema nastavnicima, studentima i zaposlenicima.

Tablica 1. Moguće aktivnosti tijekom semestra, „pragovi", preporučeni udio pojedinačne aktivnosti u ukupnom broju bodova ostvarivih tijekom semestra i sl.

<table>
<tr><th>Moguće aktivnosti tijekom semestra</th><th>Maksimum bodova po uspješno položenoj aktivnosti (nastavnik određuje maksimum unutar dolje navedenog raspona)</th><th colspan="2">Minimalno potreban uspjeh iz aktivnosti da bi se smatrala uspješno položenom („prag")</th><th>Trajanje uspješno položene aktivnosti[1]</th><th>Trajanje bodova iz aktivnosti[2]</th><th>Nadoknada u slučaju neuspješno položene aktivnosti</th><th rowspan="9">Maksimalan zbroj bodova ostvarenih tijekom semestra mora biti fiksan za predmet, i to u rasponu od 40 do 70 bodova (v. Tablicu 2)
∑⇒</th></tr>
<tr><td>Pohađanje nastave (PR+AV+ +KV+LV)</td><td>od 0 do 10</td><td colspan="2">Ukupno (PR+AV+KV+LV) minimalno 70% nazočnosti[3,4,5].</td><td rowspan="5">Trajno</td><td rowspan="5">Do početka sljedećeg ciklusa nastave iz predmeta</td><td>Potrebno sljedeće ak. godine ponovno pohađati nastavu[6]</td></tr>
<tr><td>LV/KV[7]</td><td>od 0 do 30</td><td colspan="2">100 % kolokviranih vježbi</td><td>Moguće za do 30% vježbi[8]</td></tr>
<tr><td>Domaće zadaće</td><td>od 0 do 30</td><td colspan="2" rowspan="3">0 % do 50 % bodova</td><td>Moguće za do 20% bodova[h]</td></tr>
<tr><td>Seminarski rad</td><td>od 0 do 30</td></tr>
<tr><td>Dodatne aktivnosti[9]</td><td>od 0 do 30</td></tr>
<tr><td rowspan="2">Kontrolne zadaće[10]</td><td rowspan="2">od 0 do 50</td><td>Iz svake pojedinačno</td><td>Od 20 % do 50 %</td><td colspan="2" rowspan="2">Prvi sljedeći ispitni rok</td><td rowspan="2">Pismeni ispit (v. redak ispod za detalje)</td></tr>
<tr><td>Kumulativno</td><td>50 %</td></tr>
<tr><td>Pismeni ispit[11]</td><td>Jednako broju bodova za aktivnost „Kontrolne zadaće" [12]</td><td colspan="2">50 %[13]</td><td colspan="3">Na tekućem ispitnom roku</td></tr>
</table>

[1] Za vrijeme navedenog trajanja se smatra da je aktivnost uspješno položena (pa i u slučaju da je isteklo vrijeme „trajanja bodova iz aktivnosti", v. sljedeću fusnotu).

[2] Za vrijeme navedenog trajanja se računaju bodovi ostvareni iz aktivnosti , odnosno nakon isteka navedenog trajanja se bodovi izjednačavaju sa nulom, ali se aktivnost i dalje smatra uspješno položenom sve dok ne istekne vrijeme „trajanja uspješno položene aktivnosti" (v. prethodnu fusnotu).

[3] Navedeni prag se ne odnosi na izvanredne studente. Na polaznike Razlikovnih obveza odnosi se postotak definiran za svaki pojedinačni predmet, a koji može biti manji od 70%. Za predmete s konzultativnim izvođenjem obavezan je dolazak na barem pet termina konzultacija.

[4] Ovo je ujedno prag i za potpis u indeks (ovjera „urednog izvršavanja obveza").

[5] Za PR, i isto tako AV, nastavnik ne može tražiti više od 70% nazočnosti.

[6] U slučaju opravdanog izostanka s nastave, nastavnik studentu može odobriti nadoknadu: PR i AV (moguće do 50% sati) u obliku veće angažiranosti na nekoj od ostalih aktivnosti ili na nekoj dodatnoj aktivnosti, za LV i KV (moguće do 30% vježbi) kako je opisano pod fusnotom „h".

[7] Obavezno provoditi ako u izvedbenom planu postoje laboratorijske ili konstrukcijske vježbe. Kolokviranje LV/KV podrazumijeva sljedeće: napisana/popunjena priprema za svaku vježbu, uspješno odrađena svaka vježba, napisan/popunjen izvještaj za svaku vježbu, uspješno položene provjere znanja iz izvještaja (prag za provjere znanja iznosi 50%). Studenti ne mogu nadoknaditi vježbe na kojima nisu bili nazočni iz neopravdanih razloga. Nenapisana/nepopunjena priprema se smatra jednakom neopravdanom izostanku s vježbi, tj. student nema pravo prisustvovati vježbi, te taj izostanak može nadoknaditi tek sljedeće ak. godine. Neuspješna provjera znanja iz priprema, odnosno netočno popunjena/napisana priprema smatra se jednakom opravdanom izostanku s vježbi, tj. student nema pravo prisustvovati vježbi, ali može nadoknaditi vježbu.

[8] Potrebno nadoknaditi najkasnije prije početka prvog sljedećeg ispitnog roka (iznimno, ako je riječ o nekoj od specifičnih dodatnih aktivnosti, npr. praktični rad u laboratoriju, projektni zadatak, i sl., nastavnik može studentima odobriti duži rok za nadoknadu ako za to postoje opravdani razlozi). Neuspješna nadoknada ili veći iznos nadoknade može se odraditi tijekom sljedećeg ciklusa nastave iz predmeta. Pritom se odrađuju samo neizvršeni dijelovi aktivnosti (npr. ponovno se odrađuju samo neodrađene LV/KV, popravlja se prethodno započeti seminarski rad, itd.).

[9] Dodatne aktivnosti mogu biti grupni zadaci na predavanjima, studentske prezentacije, praktični rad u laboratoriju, projektni zadaci i sl.

[10] Obavezno provoditi ako u izvedbenom planu postoje auditorne vježbe kao oblik provođenja nastave. Tijekom semestra se organiziraju po dvije kontrolne zadaće. Kod ove neuspješno odrađene aktivnosti student iznimno ima pravo prijave ispita kako bi mogao pristupiti pismenom ispitu kao nadoknadi za ovu aktivnost.

[11] Pismeni ispit nije aktivnost tijekom semestra, nego je nadoknada za nepoložene kontrolne zadaće. Student može pristupiti pismenom ispitu jedino ako je uspješno položio ostale aktivnosti.

[12] Nakon uspješno položenog pismenog ispita i završnog usmenog ispita, pod aktivnost kontrolnih zadaća evidentira se broj bodova ostvarenih na pismenom ispitu.

[13] Nositelj predmeta na početku ak. godine definira je li pismeni ispit eliminacijski, tj. smije li student pristupiti usmenom dijelu ispita i ako nije uspješno položio pismeni ispit. Ako student ispit polaže pred ispitnim povjerenstvom (8. izlazak ili prigovor na ocjenu), povjerenstvo pregledava pismeni ispit koji ne mora biti eliminacijski, ali se od studenta u svakom

Tablica 2. Utvrđivanje ukupnog broja bodova (UBB) i konačne ocjene

<table>
<tr><td rowspan="2">Zbroj bodova ostvarenih tijekom semestra
$\sum\Rightarrow$</td><td rowspan="2">od 40 do 70 bodova</td><td rowspan="2">Zbroj bodova ostvarenih tijekom semestra i bodova na završnom usmenom ispitu
$\sum\Rightarrow$</td><td>Ukupan broj bodova (UBB)</td><td rowspan="5">Utvrđivanje ocjene na temelju UBB
$\Rightarrow$</td><td>UBB</td><td>Konačna ocjena</td></tr>
<tr><td rowspan="4">100 bodova</td><td>90≤UBB≤100</td><td>izvrstan (5)</td></tr>
<tr><td rowspan="2">Završni usmeni ispit[14]</td><td rowspan="2">od 60 do 30 bodova</td><td>75≤UBB<90</td><td>vrlo dobar (4)</td></tr>
<tr><td>60≤UBB<75</td><td>dobar (3)</td></tr>
<tr><td>UBB<60</td><td>dovoljan (2)</td></tr>
</table>

NAPOMENE VEZANE UZ PROVJERE ZNANJA I IZVEDBENI PLAN:

- kontrolne zadaće se trebaju realizirati unutar ukupno 16, odnosno 32 sata nastave za AV sa 15, odnosno 30 sati prema izv. planu. To povećanje satnice je moguće samo ako ga je nastavnik najavio satničarima najkasnije nakon odrađenih 8, odnosno 16 sati AV. Tijekom semestra se organiziraju po dvije kontrolne zadaće u trajanju od 45 do 60 minuta za predmete sa 15 sati AV, odnosno u trajanju od 60 do 90 minuta za predmete sa 30 sati AV.
- nadoknade LV/KV sa 15, odnosno 30 sati trebaju se realizirati unutar najviše 16, odnosno 32 sata nastave. To povećanje satnice je moguće samo ako ga je nastavnik najavio satničarima najkasnije nakon odrađenih 50% satnice. Ako je to povećanje nedovoljno za nadoknade, nadoknada se može provesti u obliku provjere znanja iz priprema i izvještaja iz nekolokviranih vježbi u terminima koje je nastavnik dogovorio s pojedinačnim studentima.
- provjere znanja iz LV/KV (iz priprema i izvještaja) trebaju biti provedene tijekom termina LV/KV (npr. na početku ili na kraju svakog pojedinačnog termina) ili u posebnim terminima. Pritom satnica posebnih termina ne ulazi u izvedbeni plan niti se računa pod realizacijom izvedbenog plana. Za posebne termine će satničari osigurati mjesto u rasporedu pod uvjetom da nositelj predmeta na početku ak. godine najavi održavanje posebnih termina za provjeru znanja iz LV/KV i navede trajanje svakog termina.
- budući da nisu obavezni, kolokviji (vezani za usmeni ispit) realiziraju se izvan satnice predviđene izvedbenim planom, tj. ta satnica ne ulazi u izvedbeni plan niti se računa pod realizacijom izvedbenog plana. Pritom će satničari osigurati potrebne termine i objaviti ih u rasporedu pod uvjetom da nositelj predmeta na početku ak. godine najavi održavanje dva kolokvija tijekom semestra i navede trajanje svakog kolokvija.

slučaju očekuje i da na usmenoj provjeri znanja pokaže i znanje koje je bilo potrebno za uspješno polaganje pismenog dijela ispita.

[14] Ispitni prag na završnom usmenom ispitu iznosi 50% uspješnosti na završnom usmenom ispitu. Završni usmeni ispit se može održati i u obliku dva kolokvija tijekom semestra (prag za svaki pojedinačni iznosi od 20% do 50%, kumulativno 50%). Uspješno položeni kolokviji vrijede prvi sljedeći ispitni rok. Pritom, u slučaju da je student na jednom kolokviju imao uspješnost najmanje 50%, ali kumulativno manje od 50%, nastavnik može odobriti studentu da na usmenom ispitu odgovara parcijalno, tj. samo tematske cjeline nepoloženog kolokvija.

Za usmeni ispit (odnosno kolokvije tijekom semestra) ispitivač treba definirati u prosjeku 2 do 5 ispitnih pitanja za svaki sat predavanja. Ispitivač nije dužan ispitivati strogo prema ispitnim pitanjima, odnosno ispitna pitanja služe kao smjernice studentima za pripremu za usmeni ispit (odnosno kolokvije tijekom semestra).