SVEUČILIŠTE JOSIPA JURJA STROSSMAYERA U OSIJEKU
ELEKTROTEHNIČKI FAKULTET OSIJEK

Graduate university study programme in Electrical Engineering, branches *Communications and Informatics* and *Power Engineering*

(pursuant to the form for Proposition of amendments to the study programme)

Osijek, 2015
(version 2017/2018)

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1 INTRODUCTION

The graduate study programme in Electrical Engineering, branches Power Engineering and Communications and Informatics, has been carried out at the Faculty of Electrical Engineering Osijek since the academic year 2008/2009.

After seven years of carrying out the study programme and in addition to considering the interest and the needs of labour market, wider social community, students' interest and employees' scientific advancement, we have decided to suggest amendments to the study programme for both branches.

The amendments to the graduate university study programme in Electrical Engineering, branches Power Engineering and Communications and Informatics, will not affect the number of enrolled students, i.e. students will enrol in the following three elective modules at the branch of Power Engineering

- DE1 – Power Engineering Systems
- DE2 – Sustainable Power Engineering
- DE3 – Industrial Power Engineering

and two elective modules at the branch of Communications and Informatics

- DK1 – Communication Technology
- DK2 – Network Technology.

1.1 Provide general information about the higher education institution (name, address, telephone number, e-mail, website).

Name of the higher education institution:
Josip Juraj Strossmayer University of Osijek
Faculty of Electrical Engineering Osijek

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1.2 Who approved the initiation of amendments to the study programme (e.g. management boards, faculty council, etc.)?

The Council of the Faculty of Electrical Engineering Osijek, Josip Juraj Strossmayer University of Osijek adopted the report entitled "Proposition of amendments to the graduate university study programme in

Electrical Engineering, branches Power Engineering and Communications and Informatics" at its 177th session held on 5th May, 2015.

2 INSTITUTIONAL ASSUMPTIONS

2.0 Report on the study programme has to comprise a comparison analysis of the proposed study programmes with related accredited study programmes carried out in the Republic of Croatia or European Union. The analysis has to include the minimal institutional assumptions.

The proposed graduate university study programme in Electrical Engineering, branches Power Engineering and Communications and Informatics, is greatly based on the current graduate university study programme thus preserving the initial comparison with the quality of related accredited study programmes in the Republic of Croatia and the European Union countries.

The graduate university study programme in Electrical Engineering, branches Power Engineering and Communications and Informatics, is comparable with the majority of contemporary graduate study programmes in the Republic of Croatia as follows:

- graduate university study programme in Information and Communication Technology at the Faculty of Electrical Engineering and Computing, University of Zagreb (http://www.fer.unizg.hr/diplomski_studij/ict)
- graduate university study programme in Electrical Engineering and Information Technology at the Faculty of Electrical Engineering and Computing, University of Zagreb (http://www.fer.unizg.hr/diplomski_studij/eit)
- graduate 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.hr/studiji/elektrotehnika/diplomski)
- graduate university study programme in Electrical Engineering at the Faculty of Engineering, University of Rijeka (http://www.riteh.uniri.hr/obrazovanje/diplomski-sveucilisni-studij/elektrotehnika/)
- numerous study programmes carried out in the European Union countries as described in Chapter 3.21.

The study programmes are generally comparable because they last for two years, students acquire the same number of ECTS credits (120) and the academic title of the Master of Electrical Engineering is fully comparable in the Republic of Croatia and other European Union countries. The evidence of comparability is successful incoming and outgoing student mobility within Erasmus mobility programmes. Mobility will be continued because the basic compliance assumptions with the Bologna process will not be altered.

In addition to other Faculty employees, the teaching process quality will be ensured by 30 teachers and associates affiliated to two Faculty departments that will mainly be involved in teaching classes at the branch of Power Engineering as follows:

- Department of Power Engineering which consists of the Chair of Power Systems and Substations, Chair of Power Plants and Energy Processes and the accredited Electromagnetic Compatibility Laboratory;
- Department of Electromechanical Engineering which consists of the Chair of Fundamentals of Electrical Engineering and Measurements, Chair of Electric Machines and Power Electronics and Electric Machines and Hybrid Electric Drives Laboratory.

In addition to other Faculty employees, classes at the branch of Communications and Informatics will be taught by 16 teachers and associates affiliated to the Department of Communications which consists of the

Chair of Radiocommunications and Telecommunications, Chair of Electronics and Microelectronics and the accredited Laboratory for High Frequency Measurements.

High quality computing, measuring and simulation equipment is provided in these Departments. The equipment has already been and will be used in the following teaching laboratories which are continually being upgraded – Laboratory for Power Systems and Protection, TEMPUS EMSA Laboratory for Simulation and Analysis of Power Systems and Electricity Market, Laboratory for Renewable Energy Sources, Laboratory for Power Electronics, Laboratory for Electric Machines and Drives, Laboratory for Electrical Measurements, Laboratory for Fundamentals of Electrical Engineering, Laboratory for Fundamentals of Electrical Engineering and Electronics, Electromagnetic Compatibility Laboratory, Electric Machines and Hybrid Electric Drives Laboratory, Laboratory for Electronics and Microelectronics, Laboratory for Radiocommunications, Laboratory for Telecommunications and Laboratory for High Frequency Measurements.

A special emphasis should be put on the current quality assurance system. The Faculty of Electrical Engineering Osijek continuously evaluates the employees' work. It conducts both university and faculty questionnaires on teachers and undertakes a number of activities related to quality assurance, which makes the study programme comparable to related study programmes carried out in the Republic of Croatia and other European Union countries.

3 GENERAL INFORMATION ON THE STUDY PROGRAMME

3.1 Name of the study programme
Graduate university study programme in Electrical Engineering, branches Power Engineering and Communications and Informatics

3.2 Provider of the study programme
Josip Juraj Strossmayer University of Osijek, Faculty of Electrical Engineering Osijek

3.3 Type of the study programme
University study programme

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

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

3.8 Admission requirements

Students can enrol in the study programme pursuant to a vacancy announcement.

The graduate university study programme in Electrical Engineering can be enrolled into by students who graduated from the Faculty of Electrical Engineering Osijek and are awarded the following titles:

- University Bachelors of Electrical Engineering (students who finished the undergraduate university study programme in Electrical Engineering, elective modules of Power Engineering or Communications and Informatics);
- Bachelors who passed all differential exams at the Faculty of Electrical Engineering Osijek thus meeting the requirements for enrolling in the graduate university study programme in Electrical Engineering.

The graduate university study programme in Electrical Engineering can also be enrolled into by:

- University Bachelors of Electrical Engineering who graduated from other higher education institutions;

- University Bachelors with a specialisation in Technical or Natural Sciences.

In such cases, the Academic and Student Affairs Committee will determine differential exams to be passed.

3.9 Duration of study

The graduate university study programme lasts for two years (four semesters). A student has to obtain 120 ECTS credits.

3.10 Academic/expert title awarded upon completion of the study programme

Upon completion of the graduate study programme in Electrical Engineering, students are awarded an academic title of Master of Electrical Engineering with a reference to a specialisation in Power Engineering or Communications and Informatics.

3.16 List the competencies students acquire and activities they can perform upon completion of the study programme

Branch: Power Engineering

Graduates holding a Master's degree in Electrical Engineering with a reference to a specialisation in Power Engineering have been trained to plan, develop, design, construct, supervise, control and maintain, which involves the following activities:

- designing power plants and cogeneration systems;
- maintaining and designing electric machines;
- designing and maintaining transmission and distribution networks and lines, switching substations, city substations, distribution overhead and underground networks;
- designing protection systems and maintaining power systems;
- working in research and teaching institutions performing jobs of researching and educating in the fields of power engineering.

Since the branch is divided into three elective modules and taking into account chosen courses of the selected elective module, students acquire the following additional competencies some of which two elective modules share.

Additional competencies acquired by students studying at elective module DE1 – Power Engineering System:

- analysing power flows, short circuits, calculation loss and voltage drops in transmission and distribution networks;
- designing power lines and transformers;
- analysing production, transmission and distribution of electrical energy from a technical and economical point of view;
- measuring the quality of electrical energy and calculating power system reliability;
- analysing stability of transitional processes in power systems;

- designing and selecting switchgears and high voltage technology;
- designing protection for active power networks.

Additional competencies acquired by students studying at elective module DE2 – Sustainable Power Engineering:

- analysing power flows, short circuits, calculation loss and voltage drops in transmission and distribution networks;
- electrical and thermal applications in renewable energy power plants and advanced technologies;
- designing advanced networks, conducting technical and economic analyses and writing reports for integration of renewable energy power plants into power networks;
- calculating energy efficiency and conducting energy audits;
- designing power electronic systems for renewable energy power stations and electric vehicles;
- designing and choosing power engines in systems for producing electrical energy;
- designing and maintaining lightning, electrical installations and different complexity systems (building installations, industrial systems and renewable energy power stations).

Additional competencies acquired by students studying at elective module DE3 – Industrial Power Engineering:

- performing detailed measurements in power systems and industry;
- designing and maintaining lightning, electrical installations and different complexity systems (building installations, industrial systems and renewable energy power stations);
- testing electric drives in industrial, power, transport and technology processes;
- parametring and commissioning different types of frequency converters and soft starters;
- designing and optimising asynchronous machines by using electromagnetic calculations;
- designing power electronic systems for renewable energy power stations and electric vehicles;
- testing and parametring measuring systems for recoding and data collecting.

Branch: Communications and Informatics

Graduates holding a Master's degree in Electrical Engineering with a reference to a specialisation in Communications and Informatics are educated and trained to solve complex engineering problems in the field of communication and information systems, design communication systems, lead a team, conduct research and enhance development in the field of communication and information technology, which involves the following activities:

- working in the telecommunications industry as well as with public mobile radio network operators, radio and television concessionaires;
- installing and maintaining radio systems;
- conducting research and developing software for networks and telecommunication services;
- planning, setting up, testing and controlling public mobile and fixed telecommunication networks and the Internet;
- working in research and teaching institutions performing jobs of researching and educating in the fields of communications and informatics.

Since the branch is divided into two elective modules and taking into account chosen courses of the selected elective module, students acquire the following additional competencies:

Additional competencies acquired by students studying at elective module DK1 – Communication Technology:

- conducting research, developing and maintaining in the telecommunications industry, with public mobile radio network operators, radio and television concessionaires and transmission and broadcasting service providers;
- working in the field of business and private networks, small and medium-sized enterprises dealing with designing, installing and maintaining radio systems;
- working in public administration on planning frequencies, regulatory rules and surveillance.

Additional competencies acquired by students studying at elective module DK2 – Network Technology:

- conducting research, developing and maintaining software for networks and telecommunication services;
- planning, setting up, testing and controlling public mobile and fixed telecommunication networks, the Internet and user services;
- designing and managing business and private networks, information systems and electronic business systems with a great deal of information contents.

3.17 Describe the mechanisms used to ensure vertical mobility of students in national and international higher education space. If focusing on the first level of professional or undergraduate study programmes, list specialist graduate professional study programmes or graduate university study programmes students can enrol in the provider of the study programme or other higher education institutions in the Republic of Croatia

The current configuration of the study programmes (Figure 1) is based on the adjustments of the study programmes carried out prior to the Bologna declaration and similar current study programmes carried out at related European higher education institutions.

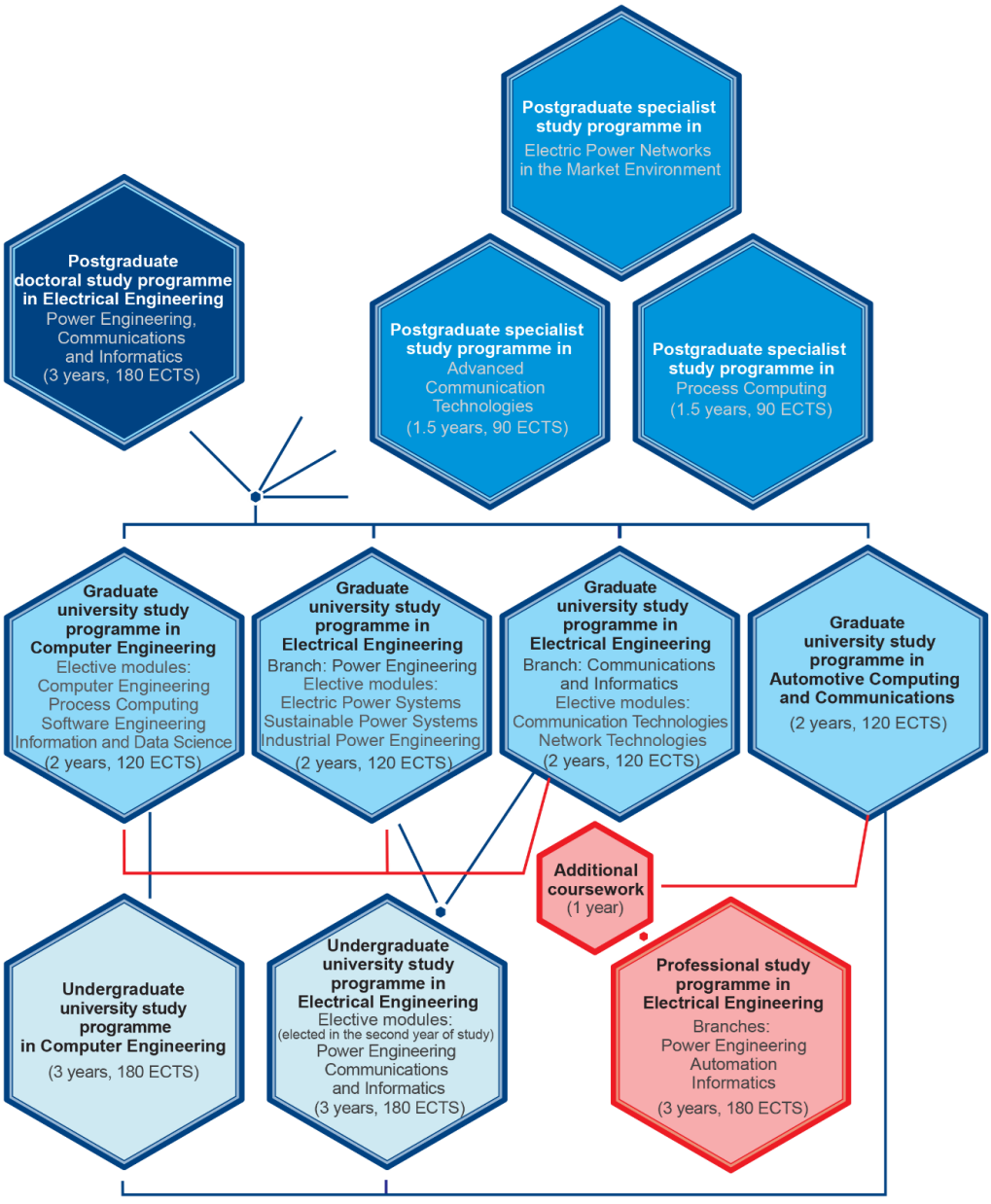

Figure 1. Vertical studying scheme at the Faculty of Electrical Engineering Osijek

Masters of Electrical Engineering who completed the graduate university study programme in Electrical Engineering are eligible to enrol in the postgraduate university specialist or doctoral study programmes in Electrical Engineering at the Faculty of Electrical Engineering Osijek (Figure 1) and at other related higher education institutions in the Republic of Croatia or abroad.

International student mobility during their studies is provided by the ERASMUS mobility programme carried out at the University since the academic year 2009/2010.

3.17.1 Courses students can take and enrol in other University constituent units

Students can choose optional courses offered at Josip Juraj Strossmayer University of Osijek every academic year in the fourth semester. For example, in the academic year 2014/2015, there were 35 courses offered by 17 University constituent units.

3.17.2 List of courses offered in a foreign language

A list of courses offered in a foreign language is provided in Chapter 4.4. 35 courses can be taught in a foreign language. 28 courses can be taught in the English language while 7 course can be taught in both the English and German language.

3.17.3 Criteria and conditions for the transfer of ECTS credits

The Faculty organises and carries out the Erasmus International Mobility Programme. The Erasmus International Mobility Programme enables students to spend one part of their studies at a foreign higher education institution or undergo practical training, which significantly contributes to their independence, cultural enrichment, foreign language skills and capability to work in a multicultural environment. 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 Academic and Student Affairs Committee 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 field

The contemporary study programme in Power Engineering is based upon rapid development of natural sciences and technology. This is particularly evident in the development of electrical engineering and electronics industry, as well as information communications technologies.
The driver of development and research in this field is certainly the market, which will continue to be the main backbone of further investment in science and research in the field of electrical engineering. Therefore, the Faculty needs to continuously follow the latest scientific knowledge through research and development, primarily through projects under the auspices of the Ministry of Science, Education and Sports, through European projects and, finally, cooperation and projects with the economy. Continuous and outstanding scientific work at the Faculty will ensure high-quality of outgoing experts in the field of electrical engineering.

Branch: Power Engineering

The proposed study programme in Power Engineering follows the latest development trends in power engineering, thereby also paying attention to fundamental skills and competences in designing and planning generation facilities, transmission and distribution networks, and industrial plants. Depending on the elective module students have opted for, additional state-of-the-art skills like techno-economic analysis of the electricity market, power quality and power system reliability, renewable energy applications in the electrical power system and energy efficiency with an emphasis on electrical energy are taught. Also, students will gain skills in state-of-the-art power electronics, automation of industrial plants from selecting equipment to finding technical solutions, as well as conducting industrial measurements for the purpose of monitoring and

control. Finally, fundamental skills in contemporary fields of electromobility of vehicles and vessels will be discussed.

Branch: Communications and Informatics

The proposed study programme in Communications and Informatics with its compulsory and elective courses offers the possibility of a narrow specialisation according to students' own interests in the field of communications and informatics, which is nowadays closely related to computer skills. These skills enable students to research, develop, improve and maintain existing information and communications systems, but also to create new data transfer, storage and processing systems. In today's world, information has become the most important product, while communication is the foundation the development of this world is based upon. Therefore, knowledge and skills in the field of information and communications systems, which are required for their development and improvement, have a huge and direct impact on the modern society and technology development.

3.19 Explain the relationship of the study programme with the needs of a local community (economy, enterprises, civil society, etc.).

It is expected that the study will meet the needs of the local community for new jobs in terms of reducing unemployment.

Namely, the analysis of labour market data in Croatia shows that experts who complete the graduate university study programme in Electrical Engineering find employment much faster, even in conditions of high unemployment. Communications and informatics as well as power engineering constitute an important foundation for the development of every society, and the Faculty of Electrical Engineering Osijek is the only institution in Eastern Croatia that educates experts in these areas, which is thus the foundation for future successful education of experts in the field of electrical engineering, but also for retention and recruitment of highly educated staff, as well as economic growth and development, both in the region and in Croatia as a whole.

Together with the undergraduate university study programme in Electrical Engineering, the graduate university study programme in Electrical Engineering creates a logical unit and rounds up the education of experts in this field. With their own additional competencies, graduates holding a Master's degree in Electrical Engineering will be capable of dealing with complex problems such as research and development as well as the application of new technologies in power engineering, the industry and the information and communications sector.

Today, electrical engineering is present in all segments of human life and it is not possible to imagine the overall social and economic development of modern society, including Croatia, without electrical engineering. It is beyond doubt that electrical engineering will continue to be the driver of the development of society, which will require highly educated experts, who will be able to respond to the challenges of the new era. The highly educated experts in electrical engineering, who are educated at the Faculty of Electrical Engineering in Osijek, have found their way into the labour market and will continue to do so with additional modern skills and competencies.

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

Branch: Power Engineering

- The graduate university study programme in Electrical Engineering, branch Power Engineering, is highly comparable to the Master's programme in Engineering at Kungliga Tekniska Högskolan (KTH), Stockholm University, Sweden: the course “Power System Analysis” corresponds to our course “Power System Analysis”; “Power Generation Operation and Planning” corresponds to our courses “Power Plants” and “Power System Planning”; “Power Grid Technology and Substation Design” corresponds to “Electric Power Substations“; the course “Electrical Machines and Drives” corresponds to our courses “Electrical Machines” and “Electric Drives”; “Power Electronics” corresponds to our course “Application of Power Electronics in Power Engineering and Electromobility”; “Advanced Measurements in Electrotechnical Systems” corresponds to our courses “Electrical and Magnetic Measurements“ and “Industrial Measurements”; “Power Generation, Environment and Markets” corresponds to “Power Plants” and “Power System Economics and Electricity Market”; “FACTS and HVDC in Electric Power System” partially corresponds to our course “Transmission and Distribution of Electrical Energy”; “High-Voltage Engineering” corresponds to “Switching Devices and High-Voltage Engineering”; “Electrotechnical Design” corresponds to our course “Design of Electrical Installations, Lighting and Facilities”; “Reliability Evaluation of Electrical Power Systems” partially corresponds to the course “Quality and Reliability in Electric Power Systems”; “Smart Electrical Networks and Systems” corresponds to our course “Integration of Renewable Energy Sources and Smart Grids”; the course “Power System Stability and Control” corresponds to courses “Power System Stability and Reliability” and “Power System Operation Control”, “Power System Protection” corresponds to our course “Power System Protection”; the course “Electromagnetic Compatibility” corresponds to our course “Electromagnetic Compatibility”, etc.

- The graduate university study programme in Electrical Engineering, branch Power Engineering, is also highly comparable to the Master’s degree in Energy Engineering, Specialisation in Electrical Energy, UPC Barcelona: “Energy Resources” and “Energy Environment” correspond to our undergraduate course entitled “Fundamentals of Power Engineering and Ecology”, which is a prerequisite for graduate admission; the course “Power Grid System” corresponds to our courses “Power System Analysis” and “Transmission and Distribution of Electrical Energy”; “Renewable Energy Technology” corresponds to “Renewable Electricity Sources” and partially also to “Power Machinery and Thermal Applications of Renewable Energy Sources”; “Thermal Equipment” partially corresponds to “Power Machinery and Thermal Applications of Renewable Energy Sources” and the undergraduate course “Energy Conversions”; the course “Electrical Equipment” corresponds to the courses “Power System Analysis” and “Transmission and Distribution of Electrical Energy”; “Economics and Energy Markets” corresponds to “Power System Economics and Electricity Market”; “Energy Efficiency and Rational Use of Energy” corresponds to our course “Energy Efficiency”; the course “Design, Simulation and Control of Electrical Machinery” corresponds to “Electrical Machines”; “Power Electronics Applied to Distributed Energy Resources” corresponds to our course “Application of Power Electronics in Power Engineering and Electromobility”; “Electric Drives with High Efficiency and Low Environmental Impact” partially corresponds to our course “Electric Drives”; “Power Generation from Renewable Energy Sources” corresponds to “Renewable

Electricity Sources"; the courses "Quality of Power Supply and Integration of Renewables in the Network" and "Smart Grids" correspond to our course "Integration of Renewable Energy Sources and Smart Grids"; and the course "Advanced Electrical Engineering" corresponds to "Design of Electrical Installations, Lighting and Facilities".

- The graduate university study programme in Electrical Engineering, branch Power Engineering, is highly comparable to the following study programmes: Master of Science in Electric Power Engineering (MSELPOWER), Energy Use and Energy Planning (MIENERG) and Wind Energy (MSWIND) at the National Technical University Athens, Greece (NTUA) as follows: the course "Electrical Machines" corresponds to our course "Electrical Machines"; "Power System Analysis" corresponds to our course "Power System Analysis"; "Electrical Drives" corresponds to our course "Electric Drives"; the course "Overvoltages and Overvoltage Protection" partially corresponds to our courses "Power System Protection", "Quality and Reliability in Electric Power Systems" and "Power System Stability and Reliability"; "Planning and Operation of Energy Systems" corresponds to "Power System Planning"; the course "Energy Systems" corresponds to our courses "Power Plants" and "Renewable Electricity Sources"; the courses "Insulating Materials for High Voltage Applications" and "High Voltage Equipment" correspond to our course "Switching Devices and High-Voltage Engineering"; the course "Electric Power System Stability" partially corresponds to "Power System Stability and Reliability"; "Power Markets, Resources and Environment" partially corresponds to our course "Power System Economics and Electricity Market"; the course "Power Electronics for Renewable Energy" partially corresponds to our course "Application of Power Electronics in Power Engineering and Electromobility", etc.

- The graduate university study programme in Electrical Engineering, branch Power Engineering, is highly comparable to the following study programmes: Master of Electrical Power Systems Engineering at the University of Manchester UMIST School of Electrical and Electronic Engineering, Manchester, Great Britain: the course "Advanced Power System Analysis" corresponds to our course "Power System Analysis"; "Power System Operation and Economics" corresponds to our courses "Power System Operation Control" and "Power System Economics and Electricity Market"; "Power System Plant, Asset Management and Condition Monitoring" corresponds to "Power Plants"; the course "Power System Protection" corresponds to our course "Power System Protection"; "Power System Dynamics & Quality of Supply" corresponds to our courses "Power System Stability and Reliability" and "Quality and Reliability in Electric Power Systems"; and the course "Smart Grids & Sustainable Electricity Systems" corresponds to our courses "Renewable Electricity Sources" and "Integration of Renewable Energy Sources and Smart Grids".

- The graduate university study programme in Electrical Engineering, branch Power Engineering, is highly comparable to the Master study programme, Faculty of Electrical Engineering, University of West Bohemia Plzen (UWB), Czech Republic. Courses "Applied Electrical Engineering" and "Industrial Electronics and Electromechanical Engineering" taught at the Faculty of Electrical Engineering UWB are comparable to elective module E3 courses, part of elective module E1 courses and a smaller part of elective module E2 courses as follows: "Electrical Measurement" and "Electrical Measurement 2" correspond to our course "Electrical and Magnetic Measurements"; "Electromagnetic Compatibility" corresponds to our course "Electromagnetic Compatibility"; some sections of the courses "Design of Electrical Machines 1", "Electrical Machines", "Theory of Electrical Machines 1" and "Theory of Electrical Machines 2" correspond to our course "Electrical Machines"; "Applications of Computer in Control Systems" partially corresponds to our course

"Industrial Informatics"; courses "Electrical Drives Design" and "Electrical Drives" partially correspond to our course "Electric Drives"; "Power Plants I" and "Power Plants II" correspond to our course "Power Plants"; some sections of the courses "Measurement of Non-Electrical Values", "Measuring and Testing of Electrical Devices" and "Electronic Measuring Systems" correspond to our course "Industrial Measurements"; "Electrical Lighting" partially corresponds to our course "Design of Electrical Installations, Lighting and Facilities"; some sections of the courses "Electrical Drives", "Power Electronics" and "Electronic Power Supplies" correspond to our course "Application of Power Electronics in Power Engineering"; "Electrical Power Engineering" partially corresponds to our course "Electric Power Substations"; "Protection and Safety Systems" corresponds to our course "Power System Protection"; and the course "Electrodynamics in Electrical Power Engineering" partially corresponds to our course "Dynamics of Industrial Systems".

- The graduate university study programme in Electrical Engineering, branch Power Engineering, is in large part comparable to the Second cycle degree programme, School of Engineering and Architecture, University of Bologna, Italy. Courses taught in the branch Electrical Energy Engineering at the School of Engineering and Architecture, University of Bologna, Italy, are comparable to elective module E3 courses and a smaller part of elective module E1 and E2 courses as follows: "Applied Electromagnetism" partially corresponds to our course "Application of Electromagnetic Theory in Power Engineering"; "Electronic Measuring Instruments" partially corresponds to our course "Electrical and Magnetic Measurements"; "Design Methodologies of Electrically-Operated Machines" corresponds to our course "Electrical Machines"; "Electric Drives for Industrial and Wind Energy Applications" partially corresponds to our course "Electric Drives"; "Energy Systems Engineering" and "Power Plants and Distributed Generation" correspond to our course "Power Plants"; "Measurements and Test of Electrical Machines and Systems" and "Sensors and Transducers for Industry and Environment" partially corresponds to our course "Industrial Measurements"; "Enertronics" partially corresponds to our course "Application of Power Electronics in Power Engineering and Electromobility"; "Power Systems" partially corresponds to our course "Electric Power Substations"; and the course "Electromechanical Systems Modelling" partially corresponds to our course "Dynamics of Industrial Systems".

- More than half of the courses taught within the framework of the graduate university study programme in Electrical Engineering, branch Power Engineering, are comparable to the Master study programme, School of Engineering, the University of Padua, Italy. Courses taught within the Electrical Energy Engineering Master Course, School of Engineering, the University of Padua, Italy, partially correspond to elective module E1, E2 and E3 courses as follows: "Electrical Measurements" corresponds to our course "Electrical and Magnetic Measurements"; "Electrical Machine Dynamics" partially corresponds to our course "Electrical Machines"; "Electrical Machine Dynamics" partially corresponds to our course "Electric Drives"; "Electric Power Plants" corresponds to our course "Power Plants"; "Industrial Measurements" partially corresponds to our course "Industrial Measurements"; some sections of the course "Static Power Converters" correspond to our course "Application of Power Electronics in Power Engineering and Electromobility"; and "Electric Power Systems" corresponds to our course "Electric Power Substations".

- More than half of the courses taught within the framework of the graduate university study programme in Electrical Engineering, branch Power Engineering, are comparable to the Second-cycle programme, Faculty of Electrical, Electronic, Computer and Control Engineering, Lodz University of Technology, Poland: The following courses taught in the branch Electric Power

Engineering are to some extent comparable to elective module E3 courses and to a lesser extent to elective module E1 and E2 courses: “Analysis of Electric Field” partially corresponds to our course “Application of Electromagnetic Theory in Power Engineering”; some sections of the course “Electrical Machines in Power Engineering” correspond to our course “Electrical Machines”; the course “Programmable Controllers” corresponds to our course “Industrial Informatics”; “Electromechanical Drive Systems” corresponds to our course “Electric Drives”; some sections of the course “Measurements of Non-electrical Values” correspond to our course “Industrial Measurements”; some sections of the courses “Short Circuits in Power Systems” and “Electrical Power Systems” correspond to our course “Electric Power Substations”; the course “Power System Protection” corresponds to our course “Power System Protection”; and the course “Field-Circuit Methods” partially corresponds to our course “Dynamics of Industrial Systems”.

Branch: Communications and Informatics

- The graduate university study programme in Electrical Engineering, branch Communications and Informatics, is highly comparable to the Master Programme Telecommunications, TU Vienna, Austria. The following courses at the TU Vienna are comparable to the graduate university study programme in Electrical Engineering, branch Communications and Informatics, elective module DK1 - Communication Technology: the courses “RF Techniques”, “Advanced RF Technique”, “Electromagnetic Compatibility” and “Advanced Methods in Mathematical Modelling” correspond to our course “Electromagnetic Fields and Waves”; the courses “Parameter Estimation Methods” and “Advanced Methods in Mathematical Modelling” correspond to the course “Numerical Mathematics”; the courses “Communications Networks 1, 2” correspond to the course “Computer Networks”; the courses “Formal Method in Computer Science”, “Operating Systems”, “Software Engineering 2” and “Operating System and Software Engineering” correspond to the courses “Advanced Programming”, “Advanced Web Programming” and “Green Computing”; the courses “Digital Integrated Circuits” and “Design of Integrated Circuits” correspond to the course “Microelectronics”; the courses “RF Techniques” and “Advanced RF Techniques” correspond to the course “Transmitters”; the courses “Wireless Communications 1, 2” and “Advanced RF Techniques” correspond to the course “Radio-Relay and Satellite Communications”; the courses “RF Techniques”, “Advanced RF Techniques”, “Parameter Estimation”, “Advanced Methods in Mathematical Modelling” and “Advanced Wireless Communications 1, 2, 3” correspond to the course “Antennas”; the courses “Optical Communications”, “Optical Systems” and “Optoelectronic Integrated Circuits” correspond to the course “Optoelectronic Communications”; the courses “Wireless Communications 1, 2” and “International Seminar on Mobile Communications” correspond to the course “Mobile Communications”; the courses “RF Techniques”, “Advanced RF Techniques”, “Signal Detection”, “Wireless OFDM Systems” and “Optical Systems” correspond to the course “Receivers”; the course “Microelectromechanical Systems” corresponds to a large extent to the course “Application of Microcontroller Systems”; the courses “Communications Networks 1, 2” largely correspond to the course “Digital Video Technique”; the courses “Digital Integrated Circuits”, “Analog Integrated Circuits” and “Photonics 2” cover a large part of the content in the course “Biomedical Engineering”; the courses “Formal Method in Computer Science”, “Operating Systems” and “Software Engineering 2” largely correspond to the courses “Advanced Web Programming” and “Green Computing”.

- The graduate university study programme in Electrical Engineering, branch Communications and Informatics, is highly comparable to the Master Programme in Information and Communication Technology and Telecommunications, TU Vienna, Austria. The following courses at the TU Vienna are comparable to the graduate university study programme in Electrical Engineering, branch Communications and Informatics, elective module DK2 - Network Technology: the courses “RF Techniques”, “Advanced RF

Technique", "Electromagnetic Compatibility" and "Advanced Methods in Mathematical Modelling" correspond to our course "Electromagnetic Fields and Waves"; the courses "Signal Processing 1, 2" and "Digital Communications 1, 2" correspond to our course "Digital Signal Processing"; the courses "Communications Networks 1, 2" correspond to the course "Computer Networks"; the courses "Formal Method in Computer Science", "Operating Systems", "Software Engineering 2", "Operating System" and "Software Engineering" correspond to courses "Advanced Programming", "Advanced Web Programming", "Internet Programming", "Object Based Programming", "Internet of Things" and "Green Computing"; the courses "Digital Communications 1, 2" and "Information Theory for Communications Engineers" correspond to the course "Codes and Coding"; the courses "Network Security" and "Network Security - Advanced Topics" correspond to the course "Computer Systems Security"; the courses "Formal Method in Computer Science", "Operating Systems" and "Software Engineering 2" cover a large part of the content in the course "Mobile Platform Application Development"; the courses "Digital Communications 1, 2" correspond to the course "Communication Protocols"; the courses "Digital Communications 1, 2" correspond to the course "Digital Video Technique"; the courses "Digital Integrated Circuits", "Analog Integrated Circuits" and "Photonics 2" cover part of the content in the course "Biomedical Engineering"; the courses "Formal Method in Computer Science", "Operating Systems" and "Software Engineering 2" largely correspond to the courses "Advanced Web Programming" and "Green Computing".

- The graduate university study programme in Electrical Engineering, branch Communications and Informatics, is highly comparable to the study programme in Communication System and Networks, FHS Cologne, Germany. The following courses at the TU Vienna are comparable to the graduate university study programme in Electrical Engineering, branch Communications and Informatics, elective module DK1 - Communication Technology: the course "RF System Design" partially corresponds to our course "Electromagnetic Fields and Waves"; the course "Höhere Ingenieurmathematik" largely corresponds to our course "Numerical Mathematics"; the courses "Next Generation Networks" and "Planung, Realisierung, Optimierung und Inbetriebnahme von Kommunikationsnetzen" correspond to the course "Computer Networks"; the courses "Database Systems" and "Programming and Software Development" (Programme: Applied Information Science) correspond to the course "Advanced Programming"; the course "RF System Design" corresponds to the course "Transmitters"; the courses "Advance Multimedia Communications" and "Audio-Video Coding" correspond to the course "Multimedia Systems"; the course "RF System Design" corresponds to the course "Antennas"; the course "Optische und drahtlose Übertragungnetze" corresponds to the course "Optoelectronic Communications"; the courses "Optische und drahtlose Übertragungnetze", "Advance Multimedia Communications" and "Routing und Traffic Engineering" partially correspond to "Mobile Communications"; the courses "RF System Design", "Digital Communications" and "Optische und drahtlose Übertragungnetze" correspond to the course "Receivers"; the course "Business Management Information" corresponds to the course "Management"; the courses "Projektleitung" und "Forschungsprojekt Teil A und B" correspond to the course "Project Management"; the course "Digital Communications" largely corresponds to the course "Digital Video Technique"; the courses "Web Applications and Web Services", "Database Systems" and "Programming and Software Development" correspond to the course "Advanced Web Programming"; the courses "Database Systems" and "Programming and Software Development" largely correspond to the course "Green Computing".

- The graduate university study programme in Electrical Engineering, branch Communications and Informatics, is highly comparable to the study programme in Communication System and Networks, FHS Cologne, Germany. The following courses at the TU Vienna are comparable to the graduate university study programme in Electrical Engineering, branch Communications and Informatics, elective module DK2 - Network Technology: the course "RF System Design" partially corresponds to our course "Electromagnetic

Fields and Waves"; the course "Digital Signal Processing" largely corresponds to the course "Digital Signal Processing"; the courses "Next Generation Networks" and "Planung, Realisierung, Optimierung und Inbetriebnahme von Kommunikationsnetzen" correspond to the course "Computer Networks"; the course "Programming and Software Development" partially corresponds to the course "Advanced Programming"; the courses "Advanced Channel Coding"; "Audio-Video Coding" and "Digital Communications" correspond to the course "Codes and Coding"; the courses "Programming and Software Development" and "Web Applications and Web Services" partially correspond to the course "Internet Programming"; the courses "Advance Multimedia Communications" and "Audio-Video Coding" correspond to the course "Multimedia Systems"; the courses "Sicherheit in Netzten", "Informationssicherheit" and "Cryptography" correspond to the course "Computer Systems Security"; the courses "Programming and Software Development" and "Web Applications and Web Services" partially correspond to the course "Mobile Platform Application Development"; the course "Programming and Software Development" partially corresponds to the course "Object Based Programming"; the courses "Optische und drahtlose Übertragungnetze", "Communication Systems", "Advance Multimedia Communications" and "Routing und Traffic Engineering" partially correspond to the course "Mobile Communications"; the courses "Next Generation Networks", "Planung, Realisierung, Optimierung und Inbetriebnahme von Kommunikationsnetzen" and "Routing und Traffic Engineering" correspond to the course "Communication Protocols"; the course "Programming and Software Development" partially corresponds to the course "Internet of Things"; the course "Project Management" corresponds to the course "Management"; the course "Digital Communications" largely corresponds to the course "Digital Video Technique"; the courses "Web Applications and Web Services", "Database Systems" and "Programming and Software Development" correspond to the course "Advanced Web Programming"; the courses "Database Systems" and "Programming and Software Development" partially correspond to the course "Green Computing".

- The graduate university study programme in Electrical Engineering, branch Communications and Informatics, is highly comparable to the Master Programme in Communication Engineering, Chalmers University of Technology, Sweden. The following courses at Chalmers University of Technology are comparable to the graduate university study programme in Electrical Engineering, branch Communications and Informatics, elective module DK1 - Communication Technology: the courses "Electromagnetic Waves and Components", "Antenna Engineering" and "Microwave Engineering" correspond to our course "Electromagnetic Fields and Waves"; the course "Computer Networks" corresponds to our course "Computer Networks"; a smaller part of the course "Programming Language Technology" corresponds to our course "Advanced Programming"; the course "Introduction to Integrated Circuit Design" corresponds to the course "Microelectronics"; the courses "Introduction to Communication Engineering", "Wireless Communications" and "Antenna Engineering correspond to the course "Transmitters"; the courses "Multimedia/Video Communications", "Image Analysis" and "Image Processing" correspond to our course "Multimedia Systems"; the course "Satelite Communication" corresponds to the course "Radio-Relay and Satellite Communications"; the course "Antenna Engineering" corresponds to the course "Antennas"; the courses "Optoelectronics" and "Fiber-Optical Communications" correspond to the course "Optoelectronic Communications"; the courses "Wireless Networks" and "Multimedia/Video Communications" correspond to our course "Mobile Communications"; the courses "Introduction to Communication Engineering", "Antenna Engineering" and "Fiber-Optical Communications" correspond to our course "Receivers"; the courses "Applied Signal Processing" and "Remote Sensing" correspond to a large extent to the course "Application of Microcontroller Systems"; the courses "Digital Communications" and "Multimedia/Video Communications" correspond to the course "Digital Video Technique"; the courses "Introduction to Electronic System Design", "Mixes-Signal System Design" and "Introduction to Integrated Circuit Design" cover a large part of the content in the course "Biomedical Engineering"; the courses "Programming Language Technology",

“Functional Programming”, “Computer Graphic” and “Concurrent Programming” partially correspond to our courses “Advanced Web Programming” and “Green Computing”.

- The graduate university study programme in Electrical Engineering, branch Communications and Informatics, is highly comparable to the Master Programme in Computer Systems and Networks, Chalmers University of Technology, Sweden. The following courses at Chalmers University of Technology are comparable to the graduate university study programme in Electrical Engineering, branch Communications and Informatics, elective module DK2 - Network Technology: the courses “Electromagnetic Waves and Components”, “Antenna Engineering” and “Microwave Engineering” correspond to our course “Electromagnetic Fields and Waves”, the course “Applied Signal Processing” corresponds to the course “Digital Signal Processing”; the course “Computer Networks” corresponds to our course “Computer Networks”; a smaller part of the course “Programming Language Technology” corresponds to our course “Advanced Programming”; the courses “Error Control Coding” and “Information Theory Advanced Level” correspond to our course “Codes and Coding”; the courses “Multimedia/Video Communications”, “Image Analysis” and “Image Processing” correspond to our course “Multimedia Systems”; the course “Network Security” corresponds to the course “Computer Systems Security”; the courses “Wireless Networks” and “Multimedia/Video Communications” correspond to the course “Mobile Communications”; the course “Information Theory Advanced Level” corresponds to our course “Communication Protocols”; the courses “Digital Communications” and “Multimedia/Video Communications” correspond to the course “Digital Video Technique”; the courses “Introduction to Electronic System Design”, “Mixes-Signal System Design” and “Introduction to Integrated Circuit Design” cover a large part of the content in the course “Biomedical Engineering”; the courses “Programming Language Technology”, “Functional Programming”, “Computer Graphic” and “Concurrent Programming” partially correspond to our courses “Internet Programming”, “Advanced Web Programming”, “Object Based Programming” and “Green Computing”.

- The graduate university study programme in Electrical Engineering, branch Communications and Informatics, is highly comparable to the Master Programme in Telecommunications Engineering – track Communications, Politecnico Di Milan, Italy – School of Industrial and Information Engineering, Italy. The following courses at the Politecnico Di Milan, School of Industrial and Information Engineering, are comparable to the graduate university study programme in Electrical Engineering, branch Communications and Informatics, elective module DK1 - Communication Technology: the courses “Electromagnetic Compatibility” and “Microwave Engineering” correspond to our course “Electromagnetic Fields and Waves”; the courses “Numerical Analysis” and “Mathematical Methods in Engineering” correspond to the course “Numerical Mathematics”; the course “Network Design” corresponds to “Computer Networks”; the course “Electronic Systems” corresponds to the course “Microelectronics”; the courses “RF Systems”, “Radio and Optical Wave Propagation”, “Radiofrequency Measurement” and “Wireless Communications” correspond to our courses “Transmitters” and “Receivers”; the courses “Audio and Video Signals” and “Multimedia Internet” correspond to the course “Multimedia Systems”; the course “RF Systems” and “Wireless Communications” correspond to the course “Radio-Relay and Satellite Communications”; the course “Antennas” corresponds to our course “Antennas”; the courses “Optical Communications” and “Photonic Devices” correspond to our course “Optoelectronic Communications”; the course “Wireless and Mobile Propagation” corresponds to the course “Mobile Communications”; the courses “Digital Communications” and “Video Signals” largely correspond to the course “Digital Video Technique”; the courses “Electronic Systems” and “Video Signals” partially correspond to the course “Biomedical Engineering”.

- The graduate university study programme in Electrical Engineering, branch Communications and Informatics, is comparable in large part to the Master Programme in Telecommunications Engineering –

track Networks, Politecnico Di Milan, Italy. are comparable to the graduate university study programme in Electrical Engineering, branch Communications and Informatics, elective module DK2 - Network Technology: the courses “Communication Signal Processing I” and “Digital Video Processing” correspond to the course “Digital Signal Processing”; the course “Communication Network Design“ corresponds to the course “Computer Networks”; the courses “Digital Communications”, “Network Security and Cryptography”, “Traffic Theory” and “Embedded Systems 1” correspond to the course “Codes and Coding”; the courses “Audio Signals”, “Video Signals” and “Multimedia Internet” correspond to the course “Multimedia Systems”; the courses “Network Security Cryptography” and “Computer Security” correspond to the course “Computer Systems Security”; the course “Design and Implementation of Mobile Applications” corresponds to our course “Mobile Platform Application Development”; the course “Wireless and Mobile Propagation” corresponds to the course “Mobile Communications”; the courses “Network Security and Cryptography”, “Traffic Theory”, “Switching and Routing” and “Data Management for the Web” correspond to the course “Communication Protocols”; the course “Internet of Things” corresponds to our course “Internet of Things”; the courses “Video signals” and “Digital Communications” correspond to the course “Digital Video Technique”.

Based upon the comparison of the proposed graduate university study programme in Electrical Engineering, branches Power Engineering and Communications and Informatics, with the aforementioned study programmes, it can be concluded that there is a high level of harmonisation of the proposed study programme with the study programmes considered, which provides the possibility of exchange and flow of electrical engineering students and the teaching staff between Josip Juraj Strossmayer University of Osijek and European universities.

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

Thirty-seven years of tradition in the education of experts in electrical engineering in Slavonia make the Faculty of Electrical Engineering in Osijek a relevant constituent unit of Josip Juraj Strossmayer University of Osijek, recognised in Slavonia, Croatia and Europe.

During the thirty-seven years of the Faculty’s existence, over 4000 students have earned their degrees:

- pre-Bologna professional study programme in Electrical Engineering: 1062
- pre-Bologna university study programme in Electrical Engineering: 950
- undergraduate university study programme in Electrical Engineering: 687
- undergraduate university study programme in Computer Engineering: 432
- undergraduate professional study programme in Electrical Engineering: 608
- graduate university study programme in Electrical Engineering: 414
- graduate university study programme in Computer Engineering: 204
- postgraduate doctoral study programme in Electrical Engineering: 48

The graduate university study programme in Electrical Engineering, branches: Power Engineering, Communications and Informatics, has been carried out since academic year 2008/2009 as a continuation of the undergraduate university study programme in Electrical Engineering (elective modules: Power Engineering, Communications and Informatics), which has been carried out since academic year 2005/2006.

Amendments to the study programme have been proposed based on our own cognition about the need to modernise the teaching content and adjust it to the labour market requirements, as well as owing to contacts and conversation with colleges from other (Croatian and foreign) universities, analysis results of study success and feedback from our alumni.

3.23 If applicable, list partners, other than higher education institutions (economy, public sector, etc.), who would participate in carrying out the proposed study programme

Through participation of external associates in field-based learning, implementation of practical training and writing of Master's theses, the following partners would be involved in the proposed study programme, whose business activities are in the field of:

- Communications and informatics: NTH, Sokol d.o.o Vinkovci, Odašiljači i veze (Transmitters and Communications), Siemens CVC, and Croatian Regulatory Authority for Network Industries (HAKOM), etc.
- Power engineering: Hrvatska elektroprivreda DP Elektroslavonija Osijek, TE-TO Osijek, NOC Velika, Hrvatski operator prijenosnog sustava (Croatian Transmission System Operator)- Transmission area Osijek, Cogeneration plant Strizivojna-Hrast, biogas plants Žito, Mala Branjevina and Osatina Ivankovo, etc.

In addition, employees of the RT-RK Institute Osijek would participate in professional and practical training of students through writing of final papers and Master's theses, maximising engineering potential through training and project development, as well as additional education of students.

4 STUDY PROGRAMME DESCRIPTION

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 semester-based graduate university study programme in Electrical Engineering is composed of four semesters, i.e., two years of study, and offers two branches: Power Engineering, and Communications and Informatics.

When enrolling on the branch of Power Engineering, students can opt for the following three elective modules:
DE1 – Power Engineering Systems
DE2 – Sustainable Power Engineering
DE3 – Industrial Power Engineering

When enrolling on the branch of Communications and Informatics, students can opt for the following two elective modules:
DK1 – Communication Technology
DK2 – Network Technology

The existing graduate university study programme in Electrical Engineering forms the basis for the amended study programme. Therefore, the compulsory courses held at the present study programme are represented in each semester in all elective modules as follows:

- in Semester 1, out of four compulsory courses of the existing study programme, three courses are taught in every elective module
- in Semester 2, out of three compulsory courses of the existing study programme, at least two of them are present in each elective module
- in Semester 3, out of three compulsory courses of the existing study programme, at least two of them are present in each elective module
- in Semester 4, both compulsory courses of the existing study programme are compulsory in each elective module, including the work on the Master's thesis.

In accordance with the elective module, a student enrols on courses specific to the respective elective module as described below. Depending on the intended competences, some courses can, however, be taught in other elective modules as well. Structuring the elective courses as elective modules does not only enable specialisation of students according to their interests, but also a narrower specialisation within the respective branch.

Branch: Power Engineering

Semester 1 and Semester 2 consist of five courses per each elective module.

Semester 1:

	Course 1	Course 2	Course 3	Course 4	Course 5
DE1	Electrical Machines	Power System Analysis	Electric Power Substations	Power Lines and Transformers	Power System Economics and Electricity Market
DE2	Electrical Machines	Power System Analysis	Electric Power Substations	Energy Efficiency	Power Machinery and Thermal Applications of Renewable Energy Sources
DE3	Electrical Machines	Application of Electromagnetic	Electrical and Magnetic	Electromagnetic Compatibility	Industrial Informatics

		Theory in Power Engineering	Measurements		

Semester 2:

	Course 1	Course 2	Course 3	Course 4	Course 5
DE1	Power Plants	Transmission and Distribution of Electrical Energy	Power System Stability and Reliability	Switching Devices and High-Voltage Engineering	Quality and Reliability in Electric Power Systems
DE2	Power Plants	Transmission and Distribution of Electrical Energy	Design of Electrical Installations, Lighting and Facilities	Application of Power Electronics in Power Engineering and Electromobility	Renewable Electricity Sources
DE3	Power Plants	Electric Drives	Design of Electrical Installations, Lighting and Facilities	Application of Power Electronics in Power Engineering and Electromobility	Industrial Measurements

Semester 3 is composed of three courses, whereby students also have to undergo practical training lasting 5 weeks in a company whose area of expertise involves electrical engineering.

Semester 3:

	Course 1	Course 2	Course 3	Course 4
DE1	Power System Protection	Power System Operation Control	Protection Coordination of Active Electrical Networks	Practical Training in Electrical Engineering
DE2	Power System Protection	Power System Operation Control	Integration of Renewable Energy Sources and Smart Grids	Practical Training in Electrical Engineering
DE3	Power System Protection	Electric Power Substations	Dynamics of Industrial Systems	Practical Training in Electrical Engineering

Semester 4 is identical for all three elective modules, whereby students are obliged to opt for one elective course. Furthermore, students enrol on “Master’s thesis”, which leads to completion of the studies.

Semester 4:

	Course 1	Course 2	Course 3	Course 4
DE1 DE2 DE3 DE4	Management	Project Management	Elective Course	Master’s thesis

A list of elective courses offered in Semester 4:

Courses
Energy Efficiency of Electrical Systems
Energy Audit and Public Lighting
Elective Course – Mobility
Modeling and Control of RES Power Plants
Numerical Methods in Electromagnetism
Power System Planning
Energy Storage and Reversibility
Uninterruptible Power Supply Systems
Grounding and Earthing Systems

Note:

- In addition to the commonly offered elective courses in Semester 4, the course "Elective course-mobility" is offered and is primarily intended for recognition of courses passed at some other university in Croatia or abroad (e.g. within the Erasmus Mobility Programme). The course to be recognised has to fall into the branch being studied, but the course content differs significantly to the compulsory and optional courses offered at the study programme and can therefore not be recognised.
- In Semester 4, students are allowed to enrol in an additional elective course offered at other University constituent units. (See 4.3)

Branch: Communications and Informatics

Semester 1 and Semester 2 consist of five courses per each elective module.

Semester 1:

	Course 1	Course 2	Course 3	Course 4	Course 5
DK1	Electromagnetic Fields and Waves	Computer Networks	Advanced Programming	Numerical Mathematics	Microelectronics
DK2	Electromagnetic Fields and Waves	Computer Networks	Advanced Programming	Digital Signal Processing	Codes and Coding

Semester 2:

	Course 1	Course 2	Course 3	Course 4	Course 5
DK1	Multimedia Systems	Transmitters	Radio-relay and Satellite Communications	Antennas	Optoelectronic Communications
DK2	Multimedia Systems	Internet Programming	Computer Systems Security	Mobile Platform Application Development	Object-based Programming

Semester 3 is composed of three courses, whereby students also have to undergo practical training lasting 5 weeks in a company whose area of expertise involves electrical engineering.

Semester 3:

	Course 1	Course 2	Course 3	Course 4
DK1	Mobile Communications	Receivers	Application of Microcontroller Systems	Practical Training in Electrical Engineering
DK2	Mobile Communications	Communication Protocols	Internet of Things	Practical Training in Electrical Engineering

Semester 4 is identical for all three elective modules, whereby students are obliged to opt for one elective course. Furthermore, students enrol on "Master's thesis", which leads to completion of the studies.

Semester 4:

	Course 1	Course 2	Course 3	Course 4
DK1 DK2	Management	Project Management	Elective Course	Master's thesis

A list of elective courses offered in Semester 4:

Courses
Biomedical Electronics
Digital Video Technique
Computer System Networks - Planning and Design
Elective Course – Mobility
Advanced Web Programming
Green Computing

Note:

- In addition to the commonly offered elective courses in Semester 4, the course "Elective course-Mobility" is offered and is primarily intended for recognition of courses passed at some other university in Croatia or abroad (e.g. within the Erasmus Mobility Programme). The course to be recognised has to fall into the branch being studied, but the course content differs significantly to the compulsory and elective courses offered at the study programme and can therefore not be recognised.
- In Semester 4, students are allowed to enrol on an additional elective course offered at other University constituent units. (See 4.3)

4.2.1 Beginning and end of classes

The beginning and end of each academic year is 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 requirements for enrolment in the successive academic year has been determined by the Regulations 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 the obligations determined in the study programme
- the number of ECTS credits earned by passing the exams.

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

Students can choose optional courses offered at Josip Juraj Strossmayer University of Osijek every academic year in the fourth semester.

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

Branch: Power Engineering

Switching Devices and High-Voltage Engineering (English and German)
Power System Analysis (English and German)
Power Plants (English and German)
Power System Operation Control (English and German)
Power Machinery and Thermal Applications of Renewable Energy Sources (English and German)
Energy Storage and Reversibility (English and German)
Electrical and Magnetic Measurements (English and German)
Power Lines and Transformers (English)
Power System Economics and Electricity Market (English)
Renewable Electricity Sources (English)
Integration of Renewable Energy Sources and Smart Grids (English)
Modeling and Control of RES Power Plants (English)
Energy Efficiency of Electrical Systems (English)
Quality and Reliability in Electric Power Systems (English)
Transmission and Distribution of Electrical Energy (English)
Power System Protection (English)
Protection Coordination of Active Electrical Networks (English)
Numerical Methods in Electromagnetism (English)
Application of Electromagnetic Theory in Power Engineering (English)
Electrical Machines (English)
Electric Drives (English)
Dynamics of Industrial Systems (English)

Branch: Communications and Informatics

Electromagnetic Fields and Waves (English)
Microelectronics (English)
Multimedia Systems (English)
Antennas (English)
Optoelectronic Communications (English)

Mobile Communications (English)
Receivers (English)
Application of Microcontroller Systems (English)
Digital Video Technique (English)
Computer Networks (English)
Codes and Coding (English)
Communication Protocols (English)
Object-based Programming (English)

4.5 Describe the completion of the course of study

A student completes the graduate university study programme in Electrical Engineering by passing all the exams, preparing and defending a Master's thesis. The Master's thesis proves that a student is able to apply knowledge acquired during the studies and demonstrate that he/she is skilled to successfully solve the tasks of his/her profession suitable to the academic degree he/she has been awarded.
Details on writing and defending the Master's thesis are specified in the Faculty's Regulations on Final Papers and Master's Theses.

4.6 List the requirements for resuming interrupted studies

Students who have interrupted their studies or have lost their student status may continue their studies under conditions defined by the Statute, i.e. the Regulations on Studies and Studying of J.J. Strossmayer University of Osijek:

- a person who has lost the status of a full-time student must be allowed to complete his/her studies within a period of five years (if the student has lost his/her status during one of the study years), or ten years (if the student has lost his/her status during his/her extended study period).
- a student who has lost his/her full-time status due to interrupted studies may continue his/her studies as a full-time student, provided that the study programme has not been significantly altered.
- a student who has interrupted his/her full-time study may continue to study as a part-time student, provided that the study programme, the student has initially enrolled in, has not been significantly altered.
- a student who has lost his/her full-time status at another related university may continue his/her studies at this Faculty; however, he/she may have to pass differential exams.

5 REQUIREMENTS FOR CARRYING OUT THE STUDY PROGRAMME

5.1 Locations for carrying out the study programme

The Faculty of Electrical Engineering, J. J. Strossmayer University of Osijek has 8 000 m^2 at its disposal on three different locations, providing sufficient space for all types of curricular and extracurricular activities. The Faculty's facilities are located on the following addresses:
- Kneza Trpimira 2b (5140 m^2)
- Cara Hadrijana 10b (3260 m^2)
- Cara Hadrijana bb (barracks – building no. 14) (265 m^2).

7. APPENDICES

7.4. List of compulsory and elective courses with the number of hours of active teaching required for their performance and the number of ECTS credits

branch: Power Engineering, elective block Power Engineering systems

1. YEAR OF STUDY PROGRAM

1. semester

Code	Course	L workload	E workload	ECTS	Teacher
DEab1-02	Power System Analysis	45	30	7	Doc.dr.sc. FEKETE KREŠIMIR
DEa1-05	Power System Economics and Electricity Market	45	15	5	Doc.dr.sc. FEKETE KREŠIMIR Doc.dr.sc. KNEŽEVIĆ GORAN
DE1-01	Electrical Machines	45	30	6	Izv.prof.dr.sc. HEDERIĆ ŽELJKO
DEab1c3-03	Electric Power Substations	45	30	7	Doc.dr.sc. KNEŽEVIĆ GORAN Prof.dr.sc. BAUS ZORAN
DEa1-04-17	Power Transformers	30	30	5	Izv. prof. dr. sc. MARIĆ PREDRAG

2. semester

Code	Course	L workload	E workload	ECTS	Teacher
DE2-01	Power Plants	45	30	7	Prof.dr.sc. ŠLJIVAC DAMIR
DEa2-05	Quality and Reliability in Electric Power Systems	45	30	6	Izv. prof. dr.sc. KLAIĆ ZVONIMIR Prof.dr.sc. NIKOLOVSKI SRETE
DEab2-02	Transmission and Distribution of Electrical Energy	45	30	7	Prof.dr.sc. NIKOLOVSKI SRETE Izv. prof. dr. sc. MARIĆ PREDRAG
DEa2-04	Switching Devices and High-Voltage Engineering	30	30	5	Prof.dr.sc. BAUS ZORAN
DEa2-03	Power System Stability and Reliability	30	30	5	Izv. prof. dr. sc. MARIĆ PREDRAG

2. YEAR OF STUDY PROGRAM

3. semester

Code	Course	L workload	E workload	ECTS	Teacher

DEa3-03	Protection coordination of active electical networks	30	30	7	Prof.dr.sc. NIKOLOVSKI SRETE
DEK3-04	Professional practice in electrical engineering	0	200	9	Doc.dr.sc. GLAVAŠ HRVOJE Izv. prof.dr.sc. RUPČIĆ SLAVKO
DEab3-02	Power System Operation Control	45	30	7	Doc.dr.sc. GLAVAŠ HRVOJE
DE3-01	Power System Protection	45	30	7	Prof.dr.sc. NIKOLOVSKI SRETE

4. semester

Code	Course	L workload	E workload	ECTS	Teacher
D4-03	Diploma Paper	0	0	16	
DE4I-11	Power Lines - elective	30	30	5	Prof.dr.sc. NIKOLOVSKI SRETE
DER4I-05-17	Elements of Automation - elective	30	30	5	Prof.dr.sc. SLIŠKOVIĆ DRAŽEN Doc.dr.sc. KESER TOMISLAV
DE4I-02	Energy Audits and Public Lighting - elective	30	30	5	Doc.dr.sc. GLAVAŠ HRVOJE
D4-01	Management	30	15	4	Izv.prof.dr.sc. CRNJAC-MILIĆ DOMINIKA
DE4I-03	Modeling and Control of Renewable Power Systems - elective	30	30	5	Doc.dr.sc. TOPIĆ DANIJEL
D4F-01	German - facultative	30	30	4	FERČEC IVANKA
DE4I-04	Numerical Methods in Electromagnetism - elective	30	30	5	Izv.prof.dr.sc. HEDERIĆ ŽELJKO Izv.prof.dr.sc. BARIĆ TOMISLAV
DE4I-05	Power System Planning - elective	30	30	5	Doc.dr.sc. FEKETE KREŠIMIR Doc.dr.sc. KNEŽEVIĆ GORAN
DE4I-07	Energy Storage and Reversibility - elective	30	30	5	MAJDANDŽIĆ LJUBOMIR *
DI401-17	Service Learning Projects - elective	15	45	5	Doc.dr.sc. BARUKČIĆ MARINKO Izv. prof. dr. sc. NENADIĆ KREŠIMIR
DE4I-08	Uninterruptible Power Supply Systems - elective	45	15	5	Izv.prof.dr.sc. PELIN DENIS
DE4I-10	Thermal Applications of Renewable Energy Sources - elective	30	30	5	Doc.dr.sc. TOPIĆ DANIJEL
D4-02	Project Management	30	15	5	Prof.dr.sc. MAJSTOROVIĆ VLADO *
DE4I-09	Grounding and earthing systems - elective	30	30	5	Doc.dr.sc. KNEŽEVIĆ GORAN

branch: Power Engineering, elective block Sustainable Power Engineering

1. YEAR OF STUDY PROGRAM

1. semester

Code	Course	L workload	E workload	ECTS	Teacher
DEab1-02	Power System Analysis	45	30	7	Doc.dr.sc. FEKETE KREŠIMIR
DE1-01	Electrical Machines	45	30	6	Izv.prof.dr.sc. HEDERIĆ ŽELJKO
DEab1c3-03	Electric Power Substations	45	30	7	Doc.dr.sc. KNEŽEVIĆ GORAN Prof.dr.sc. BAUS ZORAN
DEb1-04	Energy Efficiency	30	30	5	Doc.dr.sc. GLAVAŠ HRVOJE
DEB1-06-17	Energy Efficiency of Electrical Systems	30	30	5	Doc.dr.sc. TOPIĆ DANIJEL

2. semester

Code	Course	L workload	E workload	ECTS	Teacher
DE2-01	Power Plants	45	30	7	Prof.dr.sc. ŠLJIVAC DAMIR
DEb2-05	Renewable Electricity Sources	45	30	6	Prof.dr.sc. ŠLJIVAC DAMIR
DEab2-02	Transmission and Distribution of Electrical Energy	45	30	7	Prof.dr.sc. NIKOLOVSKI SRETE Izv. prof. dr. sc. MARIĆ PREDRAG
DAEbc2-04	Applied Power Electronics	45	15	5	Izv.prof.dr.sc. HEDERIĆ ŽELJKO Izv.prof.dr.sc. PELIN DENIS
DEbc2-03	Design of Electrical Installations, Lighting and Facilities	30	30	5	Izv. prof. dr.sc. KLAIĆ ZVONIMIR

2. YEAR OF STUDY PROGRAM

3. semester

Code	Course	L workload	E workload	ECTS	Teacher
DEb3-03	Integration of Renewable Energy Sources and Smart Grids	45	15	7	Prof.dr.sc. ŠLJIVAC DAMIR Izv. prof. dr.sc. KLAIĆ ZVONIMIR
DEK3-04	Professional practice in electrical engineering	0	200	9	Doc.dr.sc. GLAVAŠ HRVOJE Izv. prof.dr.sc. RUPČIĆ SLAVKO
DEab3-02	Power System Operation Control	45	30	7	Doc.dr.sc. GLAVAŠ HRVOJE
DE3-01	Power System Protection	45	30	7	Prof.dr.sc. NIKOLOVSKI SRETE

4. semester

Code	Course	L workload	E workload	ECTS	Teacher

D4-03	Diploma Paper	0	0	16	
DE4I-11	Power Lines - elective	30	30	5	Prof.dr.sc. NIKOLOVSKI SRETE
DER4I-05-17	Elements of Automation - elective	30	30	5	Prof.dr.sc. SLIŠKOVIĆ DRAŽEN Doc.dr.sc. KESER TOMISLAV
DE4I-02	Energy Audits and Public Lighting - elective	30	30	5	Doc.dr.sc. GLAVAŠ HRVOJE
D4-01	Management	30	15	4	Izv.prof.dr.sc. CRNJAC-MILIĆ DOMINIKA
DE4I-03	Modeling and Control of Renewable Power Systems - elective	30	30	5	Doc.dr.sc. TOPIĆ DANIJEL
D4F-01	German - facultative	30	30	4	FERČEC IVANKA
DE4I-04	Numerical Methods in Electromagnetism - elective	30	30	5	Izv.prof.dr.sc. HEDERIĆ ŽELJKO Izv.prof.dr.sc. BARIĆ TOMISLAV
DE4I-05	Power System Planning - elective	30	30	5	Doc.dr.sc. FEKETE KREŠIMIR Doc.dr.sc. KNEŽEVIĆ GORAN
DE4I-07	Energy Storage and Reversibility - elective	30	30	5	MAJDANDŽIĆ LJUBOMIR *
DI401-17	Service Learning Projects - elective	15	45	5	Doc.dr.sc. BARUKČIĆ MARINKO Izv. prof. dr. sc. NENADIĆ KREŠIMIR
DE4I-08	Uninterruptible Power Supply Systems - elective	45	15	5	Izv.prof.dr.sc. PELIN DENIS
DE4I-10	Thermal Applications of Renewable Energy Sources - elective	30	30	5	Doc.dr.sc. TOPIĆ DANIJEL
D4-02	Project Management	30	15	5	Prof.dr.sc. MAJSTOROVIĆ VLADO *
DE4I-09	Grounding and earthing systems - elective	30	30	5	Doc.dr.sc. KNEŽEVIĆ GORAN

branch: Power Engineering, elective block Industrial Power Engineering

1. YEAR OF STUDY PROGRAM

1. semester

Code	Course	L workload	E workload	ECTS	Teacher
DE1-01	Electrical Machines	45	30	6	Izv.prof.dr.sc. HEDERIĆ ŽELJKO
DEc1-04	Electromagnetic Compatibility	45	15	5	Izv. prof. dr.sc. KLAIĆ ZVONIMIR Izv.prof.dr.sc. PELIN DENIS Izv. prof.dr.sc. RUPČIĆ SLAVKO
DEc1-05	Electrical and Magnetic Measurements	45	30	5	Izv.prof.dr.sc. MILIČEVIĆ KRUNO
DRb3Ec1-03	Industrial Informatics	30	45	7	Prof.dr.sc. SLIŠKOVIĆ DRAŽEN

DEc1-02	Application of Electromagnetic Theory in Power Engineering	45	30	7	Doc.dr.sc. BARUKČIĆ MARINKO

2. semester

Code	Course	L workload	E workload	ECTS	Teacher
DE2-01	Power Plants	45	30	7	Prof.dr.sc. ŠLJIVAC DAMIR
DEc2-02	Electric Drives	45	30	7	Izv.prof.dr.sc. HEDERIĆ ŽELJKO Prof.dr.sc. ERCEG GORISLAV *
DEc2-05	Industrial Measurements	30	30	6	Izv.prof.dr.sc. MILIČEVIĆ KRUNO
DAEbc2-04	Applied Power Electronics	45	15	5	Izv.prof.dr.sc. HEDERIĆ ŽELJKO Izv.prof.dr.sc. PELIN DENIS
DEbc2-03	Design of Electrical Installations, Lighting and Facilities	30	30	5	Izv. prof. dr.sc. KLAIĆ ZVONIMIR

2. YEAR OF STUDY PROGRAM

3. semester

Code	Course	L workload	E workload	ECTS	Teacher
DEc3-03	Dynamics of Industral Systems	30	30	7	Izv.prof.dr.sc. HEDERIĆ ŽELJKO Prof.dr.sc. ERCEG GORISLAV *
DEab1c3-03	Electric Power Substations	45	30	7	Doc.dr.sc. KNEŽEVIĆ GORAN Prof.dr.sc. BAUS ZORAN
DEK3-04	Professional practice in electrical engineering	0	200	9	Doc.dr.sc. GLAVAŠ HRVOJE Izv. prof.dr.sc. RUPČIĆ SLAVKO
DE3-01	Power System Protection	45	30	7	Prof.dr.sc. NIKOLOVSKI SRETE

4. semester

Code	Course	L workload	E workload	ECTS	Teacher
D4-03	Diploma Paper	0	0	16	
DE4I-11	Power Lines - elective	30	30	5	Prof.dr.sc. NIKOLOVSKI SRETE
DER4I-05-17	Elements of Automation - elective	30	30	5	Prof.dr.sc. SLIŠKOVIĆ DRAŽEN Doc.dr.sc. KESER TOMISLAV
DE4I-02	Energy Audits and Public Lighting - elective	30	30	5	Doc.dr.sc. GLAVAŠ HRVOJE
D4-01	Management	30	15	4	Izv.prof.dr.sc. CRNJAC-MILIĆ DOMINIKA
DE4I-03	Modeling and Control of Renewable Power Systems - elective	30	30	5	Doc.dr.sc. TOPIĆ DANIJEL

D4F-01	German - facultative	30	30	4	FERČEC IVANKA
DE4I-04	Numerical Methods in Electromagnetism - elective	30	30	5	Izv.prof.dr.sc. HEDERIĆ ŽELJKO Izv.prof.dr.sc. BARIĆ TOMISLAV
DE4I-05	Power System Planning - elective	30	30	5	Doc.dr.sc. FEKETE KREŠIMIR Doc.dr.sc. KNEŽEVIĆ GORAN
DE4I-07	Energy Storage and Reversibility - elective	30	30	5	MAJDANDŽIĆ LJUBOMIR *
DI401-17	Service Learning Projects - elective	15	45	5	Doc.dr.sc. BARUKČIĆ MARINKO Izv. prof. dr. sc. NENADIĆ KREŠIMIR
DE4I-08	Uninterruptible Power Supply Systems - elective	45	15	5	Izv.prof.dr.sc. PELIN DENIS
DE4I-10	Thermal Applications of Renewable Energy Sources - elective	30	30	5	Doc.dr.sc. TOPIĆ DANIJEL
D4-02	Project Management	30	15	5	Prof.dr.sc. MAJSTOROVIĆ VLADO *
DE4I-09	Grounding and earthing systems - elective	30	30	5	Doc.dr.sc. KNEŽEVIĆ GORAN

branch: Communications and Informatics, elective block Communication Technology

1. YEAR OF STUDY PROGRAM

1. semester

Code	Course	L workload	E workload	ECTS	Teacher
DK1-01	Electromagnetic fields and waves	45	30	7	Izv. prof.dr.sc. RUPČIĆ SLAVKO
DKa1-05	Microelectronics	30	45	7	Doc.dr.sc. VINKO DAVOR
DK1-02	Computer Networks	30	30	6	Prof.dr.sc. ŽAGAR DRAGO
DAK1-03	Advanced Programming	30	30	5	Izv. prof. dr. sc. HERCEG MARIJAN Doc.dr.sc. JOB JOSIP
DKa1-04	Numerical Mathematics	30	30	5	Doc.dr.sc. RUDEC TOMISLAV Doc.dr.sc. KATIĆ ANITA

2. semester

Code	Course	L workload	E workload	ECTS	Teacher
DKa2-04	Antennas	30	30	6	Izv. prof.dr.sc. RUPČIĆ SLAVKO
DK2-01	Multimedia Systems	45	30	7	Prof.dr.sc. RIMAC-DRLJE SNJEŽANA

DKa2-05	Optoelectronic Communications	30	30	5	Izv. prof.dr.sc. RUPČIĆ SLAVKO
DKa2-02	Transmitters	45	30	7	Izv. prof. dr. sc. HERCEG MARIJAN
DKa2-03	Radio-relay and Satellite Communications	30	30	5	Izv.prof.dr.sc. MATIĆ TOMISLAV (st.)

2. YEAR OF STUDY PROGRAM

3. semester

Code	Course	L workload	E workload	ECTS	Teacher
DK3-01	Mobile communications	45	30	7	Prof.dr.sc. RIMAC-DRLJE SNJEŽANA
DKa3-02	Receivers	45	30	7	Izv. prof.dr.sc. RUPČIĆ SLAVKO
DKa3-03	Application of microcontroller systems	15	45	7	Doc.dr.sc. VINKO DAVOR
DEK3-04	Professional practice in electrical engineering	0	200	9	Doc.dr.sc. GLAVAŠ HRVOJE Izv. prof.dr.sc. RUPČIĆ SLAVKO

4. semester

Code	Course	L workload	E workload	ECTS	Teacher
DK4I-02	Biomedical Electronics - elective	30	30	5	Izv.prof.dr.sc. MATIĆ TOMISLAV (st.)
DAKR4I-01	Digital Image Processing - elective	30	45	5	Prof.dr.sc. RIMAC-DRLJE SNJEŽANA
D4-03	Diploma Paper	0	0	16	
DA4R4I-10	Intelligent Transportation Systems - elective	30	30	5	Doc.dr.sc. BALEN JOSIP
D4-01	Management	30	15	4	Izv.prof.dr.sc. CRNJAC-MILIĆ DOMINIKA
DKR4I-03	Advanced Web Programming - elective	30	30	5	Doc.dr.sc. LUKIĆ IVICA
D4F-01	German - facultative	30	30	4	FERČEC IVANKA
DI401-17	Service Learning Projects - elective	15	45	5	Doc.dr.sc. BARUKČIĆ MARINKO Izv. prof. dr. sc. NENADIĆ KREŠIMIR
DRa2K4I-05	Computer System Networks - Planning and Design - elective	30	30	5	Doc.dr.sc. BLAŽEVIĆ DAMIR Doc.dr.sc. GRGIĆ KREŠIMIR
D4-02	Project Management	30	15	5	Prof.dr.sc. MAJSTOROVIĆ VLADO *
DKR4I-04	Green Computing - elective	30	30	5	Doc.dr.sc. KRPIĆ ZDRAVKO

branch: Communications and Informatics, elective block Network Technology

1. YEAR OF STUDY PROGRAM

1. semester

Code	Course	L workload	E workload	ECTS	Teacher
DRabKb1-04	Digital Signal Processing	30	30	5	Izv. prof. dr. sc. GALIĆ IRENA
DK1-01	Electromagnetic fields and waves	45	30	7	Izv. prof.dr.sc. RUPČIĆ SLAVKO
DKb1-05	Codes and Coding	45	30	7	Prof.dr.sc. ŽAGAR DRAGO
DK1-02	Computer Networks	30	30	6	Prof.dr.sc. ŽAGAR DRAGO
DAK1-03	Advanced Programming	30	30	5	Izv. prof. dr. sc. HERCEG MARIJAN Doc.dr.sc. JOB JOSIP

2. semester

Code	Course	L workload	E workload	ECTS	Teacher
DRcdKb2-02	Internet Programming	45	30	7	Izv. prof. dr. sc. NENADIĆ KREŠIMIR
DK2-01	Multimedia Systems	45	30	7	Prof.dr.sc. RIMAC-DRLJE SNJEŽANA
DAKb2-04	Object Based Programming	30	30	5	Doc.dr.sc. NYARKO EMMANUEL-KARLO Doc.dr.sc. FILKO DAMIR
DRcKb2-05	Mobile platform application development	30	30	5	Doc.dr.sc. BALEN JOSIP
DKb2-03	Computer Systems Security	30	30	6	Doc.dr.sc. GRGIĆ KREŠIMIR

2. YEAR OF STUDY PROGRAM

3. semester

Code	Course	L workload	E workload	ECTS	Teacher
DRdKb3-03	Internet of Things	30	30	7	Doc.dr.sc. JOB JOSIP Doc.dr.sc. GRBIĆ RATKO
DKb3-02	Communication Protocols	45	30	7	Prof.dr.sc. ŽAGAR DRAGO
DK3-01	Mobile communications	45	30	7	Prof.dr.sc. RIMAC-DRLJE SNJEŽANA
DEK3-04	Professional practice in electrical engineering	0	200	9	Doc.dr.sc. GLAVAŠ HRVOJE Izv. prof.dr.sc. RUPČIĆ SLAVKO

4. semester

Code	Course	L workload	E workload	ECTS	Teacher
DK4I-02	Biomedical Electronics - elective	30	30	5	Izv.prof.dr.sc. MATIĆ TOMISLAV (st.)
DAKR4I-01	Digital Image Processing - elective	30	45	5	Prof.dr.sc. RIMAC-DRLJE SNJEŽANA
D4-03	Diploma Paper	0	0	16	
DA4R4I-10	Intelligent Transportation Systems - elective	30	30	5	Doc.dr.sc. BALEN JOSIP
D4-01	Management	30	15	4	Izv.prof.dr.sc. CRNJAC-MILIĆ DOMINIKA
DKR4I-03	Advanced Web Programming - elective	30	30	5	Doc.dr.sc. LUKIĆ IVICA
D4F-01	German - facultative	30	30	4	FERČEC IVANKA
DI401-17	Service Learning Projects - elective	15	45	5	Doc.dr.sc. BARUKČIĆ MARINKO Izv. prof. dr. sc. NENADIĆ KREŠIMIR
DRa2K4I-05	Computer System Networks - Planning and Design - elective	30	30	5	Doc.dr.sc. BLAŽEVIĆ DAMIR Doc.dr.sc. GRGIĆ KREŠIMIR
D4-02	Project Management	30	15	5	Prof.dr.sc. MAJSTOROVIĆ VLADO *
DKR4I-04	Green Computing - elective	30	30	5	Doc.dr.sc. KRPIĆ ZDRAVKO

7.5. Description and general information of each subject

General information		
Lecturer	Doc.dr.sc. FEKETE KREŠIMIR	
Course name	DEab1-02 Power System Analysis	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students to the physical basics of power system operation, as well as modellelektrični strojeviing and calculation methods in the analysis of the power system.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.compare different methods for voltage regulation in a power system 2.evaluate different methods for power flow calculations 3.evaluate different methods for short circuits calculations 4.compare voltages and currents during earth fault and single line to ground fault 5.make calculations of side faults in an electrical network 6.suggest measures for power system stability improvement 7.perform a calculation of power system stability	
1.4. Course content	
Voltage regulation and control in the power system: definitions of rated voltage, voltage fluctuations and deviations, voltage drop, voltage magnitude and angle regulation, voltage regulation using different network elements, reduction of reactive power and power factor correction. Power flow calculation: mathematical model of electrical network - Y bus matrix, power flow equations in rectangular and polar form, classification of electrical nodes, power flow calculation using Gauss-Seidel and Newton-Raphson methods. Short circuit analysis: short circuit theory, classifications of different types of short circuits, calculations of currents during short circuits using IEC 60909 method. Power system stability: definitions and classifications of power system stability, static stability assessment, rotor angle dynamic stability, influence of different types of short circuits on rotor angle stability, voltage stability.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	**ECTS**	**Learning outcomes**	**Teaching method**	**Assessment method**	**Points**	
					Min	**max**
Attendance Lectures, Auditory exercises, Laboratory exercises	1.3	1,2,3,4,5,6,7	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	2.2	1,2,3,5,7	Midterm exam	Evaluation of (written) exercises	20	40
Writing pre-lab write-ups, results analysis and writing laboratory reports	2.5	1,2,3,4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	5	10
Oral exam	1	1,2,3,4,5,6,7	Oral exam	Assessment of student's answers	25	50

1.10. Obligatory literature

1. L. Jozsa: Tokovi snaga u mreži, Skripta, ETF Osijek, 2009
2. Glover, J.D; Overbye, T; M.S.; Sarma. Power System Analysis and Design, 6th Edition. Cengage Learnign, 2017.
3. S. Nikolovski: Elektroenergetske mreže - zbirka riješenih zadataka, skripta, ETF Osijek, 1998

1.11. Recommended additional literature

1. M Ožegović, K. Ožegović: Električne mreže I, II, III – udžbenik, FESB Split, 1996
2. D. Elgred: Electric Energy Systems Theory, Mc-Graw Hill, N.Y. 1983

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv. prof.dr.sc. RUPČIĆ SLAVKO	
Course name	DKa2-04 Antennas	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	6
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students to basic antenna parameters and ways of measuring them. In addition, students present methods of analysing elemental radiation sources as well as real antennas.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.define the fundamental concepts that appear in the antenna and antenna systems area 2.define and explain the basic theorems relating to antennas and elementary sources of EM radiation 3.using a mathematical model, carry out the analysis of linear dipole and unipolar antennas 4.evaluate different antennas in terms of performance, parameters and application 5.design and analyse sets of regular and irregular linear and planar point sources of radiation of the same excitation 6.evaluate MIMO antenna systems according to the most important parameters and application	
1.4. Course content	
Antenna parameters: polarisation, radiation pattern, directivity, impedance, mutual impedance, gain, effective surface, noise temperature. Basic theorems and applications. Basic EM wave sources. Near and far EM field and approximations. Fraunhofer diffraction, Fresnnel diffraction and the near field. Short dipole antennas and unipole antennas. Half-wave and full-wave dipole. A set of dotted radiation sources. Regular and irregular rays. Patch antennas radiation. MIMO antennas and transceiver systems.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
1.6. Comments	Classes can be taught in a foreign language (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. Course assessment	
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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1	1,2,3,4,5,6	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	2	5
Practice – problem solving	3	3,4,5	Midterm exam	Evaluation of (written) exercises	15	30
Writing pre-lab write-ups, results analysis and writing laboratory reports	0.5	3,4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	20	30
Oral exam	1.5	1,2,3,4,5,6	Oral exam	Assessment of student's answers	18	35

1.10. Obligatory literature

1. Zentner, E. Antene i radiosustavi. Zagreb: Graphis, 2001.
2. Balanis, C.A. Antenna Theory: Analysis and Design, 4th Edition. Wiley, 2016.

1.11. Recommended additional literature

1. R.Elliott, Antenna theory and Design, Prentice-Hall, Inc. Englewood Cliffs, N.J, 1981.
2. C.A. Balanis, Antenna Theory – Analysy and Design 3th, John Wiley & Sons, New York, 2005.
3. E.Zentner, Radiokomunikacije, Školska knjiga, Zagreb, 1980.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv.prof.dr.sc. MATIĆ TOMISLAV (st.)	
Course name	DK4I-02 Biomedical Electronics	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (elective) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(0+0+30)+0

1. Course description	
1.1. Goals	
Upon course completion, students will understand the physical basics of electrophysiology, the emergence and characteristics of the most important bioelectric signals (ECG, EEG, EMG, etc.) and the specifics of analogue and digital processing of biological signals. Students will learn how to measure impedance of biological tissues and biological non-electrical phenomena, such as blood pressure. Students will be familiar with the biomedical equipment currently used in medicine. After successfully mastering the course, they will be introduced to the architecture of basic electronic circuits within biomedical devices.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.explain the basics of electrophysiology and the emergence of biological potential 2.define the generation and characteristics of basic bioelectric signals (ECG, EEG, EMG, ERG) 3.based on the features of the biological substance and electrode interface, design a substitute electric scheme for the interface of biological substances and electrodes 4.design electronic circuits for measuring biological impedance and basic bioelectric signals (ECG, EEG, EMG) 5.design the basic architecture of wireless sensor networks on a human body 6.based on the knowledge in the basics of electrophysiology and the features of bioelectric signals, evaluate circuits for measuring bioelectric signals and nonelectric phenomena	
1.4. Course content	
Basics of electrophysiology, formation and characteristics of the most important bioelectric signals (ECG, EEG, EMG, etc.) and specifics of analogue and digital processing of biological signals. Interface between biological substance and measuring devices, types of electrodes. Block and circuit architecture of bioelectric signal measuring devices and measurement disturbances and ways to suppress them. Measurement of impedance of biological tissues and biological non-electrical phenomena, such as blood pressure measurements. Electrostimulation and electrotherapy devices. Architecture of basic electronic circuits within biomedical devices and their working principles. Body Area Networks (BAN) and signal transmission through the intra- body communication channel. VF surgical knife. Hemodialysis. Electro-medical imaging systems (X-ray, ultrasound, CT, PET, SPECT, MRI, nuclear medicine and tomography).	
1.5. Teaching methods	Lecture Construction exercises

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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Design exercises	1.5	1,2,3,4,5,6	Lectures, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Oral exam	1	1,2,3,4,5	Oral exam	Assessment of student's answers	20	40
Problem-solving related to design exercises	1	1,3,4	Design exercises	Evaluation of problem solving exercises	15	30
Seminar paper	1.5	1,2,3,4,5	Seminar work (S)	Examination of the seminar work; grading the seminar work.	0	30

1.10. Obligatory literature

1. A. Šantić: Biomedicinska elektronika, Školska knjiga, Zagreb, 1995.
2. A. Šantić: Elektronička instrumentacija, 3. izdanje, Školska knjiga, Zagreb, 1993.

1.11. Recommended additional literature

1. J.D. Bronzino: The Biomedical Engineering Handbook, Second Edition, CRC Press 1999.
2. J.J.Carr, J.M.Brown; Introduction to Biomedical Equipment Technology;Prentice Hall; 1998.
3. J. G. Webster (Ed.); Medical Instrumentation: Application and Design; John Wiley&Sons, N.Y. ; 1995.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv. prof. dr. sc. GALIĆ IRENA	
Course name	DRabKb1-04 Digital Signal Processing	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description	
1.1. Goals	
Student will learn the basic methods for digital signal processing, application of FFT in signal analysis and application of Z-transform. Student will acquire practical knowledge about design of digital filters, signal processing in time and frequency domain.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.describe different analogue to digital and digital to analogue signal conversion processes 2.analyse a discrete linear time invariant (LTI) system in a time domain and transformation domain 3.interpret and compare FIR and IIR filter designs 4.design a digital FIR and IIR filter using some of the standard filter methods in MATLAB and Simulink 5.dDefine a discrete Fourier transformation (DFT) and its properties, use it in a spectral analysis and signal processing and interpret results 6.define, apply and interpret the Fast Fourier Transformation algorithms	
1.4. Course content	
Introduction: characteristics and classification of time discrete signals. Digital processing of continuous signals: sampling, aliasing, quantisation and reconstruction. Z-transformation, convergence areas, inverse transformation, properties. Linear time invariant (LTI) discrete systems; convolution, impulse response, transfer function. Design methods for IIR and FIR filters. Properties of discrete Fourier series and transformations. Spectral analysis with DFT and FFT. Windows. Multi-resolution signal processing, decimation and interpolation, polyphase decomposition. Basics of adaptive signal processing. Basics of multidimensional signal processing. DOS applications in speech and music processing, medical imaging, radar, communication and automation.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment	

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	2	1	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	2
Practice – problem solving	1	1,2,5,6	Midterm exam	Evaluation of (written) exercises	15	30
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	12	18
Oral exam	1	1,2,3,5,6	Oral exam	Assessment of student's answers	25	50

1.10. Obligatory literature

1. V. Oppenheim, R. W. Schafer, J. R. Buck, Discrete-Time Signal Processing, Prentice Hall, 1999.

1.11. Recommended additional literature

1. M.H. Hayes, Digital Signal Processing, Schaum's outlines, McGraw-Hill, 1999.
2. K. Mitra, Digital Signal Processing: A Computer-Based Approach, Mc Graw Hill, Singapore, 2006.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. RIMAC-DRLJE SNJEŽANA	
Course name	DAKR4I-01 Digital Image Processing	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (elective) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(0+30+15)+0

1. Course description	
1.1. Goals	
Introduce students to analogue and digital television systems and applications of video coding standards in digital television. Enable students to independently develop digital TV software, including the use of a television receiver circuitry, development of middle layer software, use of digital television protocols, and download and use of data from transport stream as well as the design of the basic television application.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.describe the characteristics of video signals; choose the parameters for digitizing and compressing video signals and evaluating its quality 2.analyse the application of DCT, motion estimation and compensation as well as evaluate the application of different video coding standards 3.distinguish source and channel coding methods as well as types of modulation for DVB-T and DVB-T2 4.compare different methods of content protection as well as conditional access in a digital television 5.develop software support for a digital television receiver, including protocol usage, as well as download and use of data from the transport stream 6.design basic TV applications	
1.4. Course content	
Analogue television systems. Component and composite video signal digitization. Time and space correlation. Motion estimation and compensation, calculation of motion vectors. Texture encoding. Entropy coding. Application of MPEG-2, H.264 / AVC and H.265 standards in digital television. Video quality evaluation. Overview of standards for digital television. DVB-T: source and channel encoding, modulation, single-frequency network. Organization of program and transport streams. MPEG-2 transport stream, signaling information, and organization of the audio, video, and data stream delivery to the receiver. Architecture of DTV receiver hardware and software. Content protection, conditional access to content through DVB-CSA, DVB-CI and CI + standards. Architecture of hardware and software support of a conditional access system.	
1.5. Teaching methods	Lecture Laboratory exercises Construction exercises

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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises, Design exercises	1.8	1,2,3,4,5,6	Lectures, Laboratory exercises, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	3	5
Writing pre-lab write-ups, results analysis and writing laboratory reports	0.4	5,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	4	10
Oral exam	1.4	1,2,3,4,5	Oral exam	Assessment of student's answers	20	40
Problem-solving related to design exercises	0.9	5,6	Design exercises	Evaluation of problem solving exercises	15	30
Preparation of documentation for the project assignment	0.5	5,6	Construction exercises	Document quality verification	10	15

1.10. Obligatory literature

1. Međunarodne preporuke za digitalnu televiziju: www.etsi.org/standards, www.dvb.org/standards

1.11. Recommended additional literature

1. Walter Fischer: Digital Video and Audio Broadcasting Technology , A Practical Engineering Guide, Third Edition, Springer, 2010.
2. Harve Benoit: Digital Television-Satellite, cable, Terrestial, IPTV, Mobile TV in teh DVB Framework, Focal Press (Elsevier), 2008.
3. E.G. Richardson: H.264 and MPEG-4 video compression, John Wiley & Sons, 2003.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv.prof.dr.sc. HEDERIĆ ŽELJKO, Prof.dr.sc. ERCEG GORISLAV	
Course name	DEc3-03 Dynamics of Industral Systems	
Study program	Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce industrial plant power supply structure, power supply analysis methodology in stationary states, dynamical states and in failure conditions. Explain determination and power source selection regarding industrial plant demands. Present synchronous generator excitation dynamics, as well as stability issues of synchronous generator stability when connected to the electrical grid. Present characteristics and dynamical models of transformers and induction machines as part of industrial drives.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.create basic dynamic models of electrical drives in industrial systems and conduct simulations of operations in the required operating modes 2.define protection based on a critical analysis of the operation of drives, power sources, calculations and simulations of faulty states 3.analyse the impact of electrical drives on industrial plant voltage conditions 4.define and make a choice of industrial plant reactive power compensation 5.analyse the impact of the industrial plant on energy system in normal and failure operating conditions 6.define the basic power source configurations based on industrial plant system demand	
1.4. Course content	
Configurations and voltage levels of industrial plant power supply. System components: transformers, motors, electric power converters, filters, compensation and switching units. The electric drive dynamics in regard to electric energy converter presence. Industrial plant power supply protections. Reactive power compensation. System voltage harmonic distortions. Filter parametrisation. The power supply stability in industrial plants. Overvoltages in industry system power supplies. The interaction of industrial plant and electric grid in case of sudden disturbances in load and failure conditions.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	2	2,3,4,5,6	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Practice – problem solving	1	1,4,5,6	Midterm exam	Evaluation of (written) exercises	15	30
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	1,2,3,4	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	30
Oral exam	0.5	2,3,4,5,6	Oral exam	Assessment of student's answers	15	30

1.10. Obligatory literature

1. Weidauer, Jens. Električna pogonska tehnika (prijevod; hrvatsko izdanje). Zagreb: Graphis 2013.
2. Hartmut Kiank; Wolfang Fruith. Planning Guide for Power Distribution Plants. Siemens, 2011.
3. M. Jadrić, B. Frančić, Dinamika električnih strojeva, Graphis, Zagreb, 2000.

1.11. Recommended additional literature

1. Zia A. Yamayee, Juan L. Bala, Electromechanical energy devices and power systems, John & Sons; 1994.
2. Ion Boldea, S. A. Nasar; Electric Drives; Taylor & Francis; 2006.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer		
Course name	D4-03 Diploma Paper	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory) Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	16
	Workload (L+(AE+LE+CE)+S)	-

1. Course description	
1.1. Goals	
Define the subject and task of graduate thesis work at the appropriate scientific and professional level, so that the student needs to demonstrate the ability of the engineering work to solve problems based on concrete practical problems (measurements, calculations and design of hardware/sofware, etc.). By guiding the mentor helps the student to solve the task.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
Depends on the topic of the thesis.	
1.4. Course content	
Depends on the topic of the thesis.	
1.5. Teaching methods	Consultations
1.6. Comments	
1.7. Student obligations	
Defined by the Regulations on final and master thesis, and paragraph 1.9	
1.8. Course assessment	
Defined by the Regulations on final and master thesis, and paragraph 1.9	

1.9. Assessment and evaluation of the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Defined by Criteria for evaulation of final and diploma papers	-	-	-	-	-	-

1.10. Obligatory literature

Depends on the topic of the thesis.

1.11. Recommended additional literature

Depends on the topic of the thesis.

1.12. Monitoring of students

According to the Regulations on final and master thesis:
- the theme is approved by the Committee for final and master thesis.
- oral defence of work is carried out in front of Comission for defence

General information		
Lecturer	Doc.dr.sc. FEKETE KREŠIMIR, Doc.dr.sc. KNEŽEVIĆ GORAN	
Course name	DEa1-05 Power System Economics and Electricity Market	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	45+(0+15+0)+0

1. Course description	
1.1. Goals	
The aims of the course are to show students the implementation of the technical-economic analysis of the electric power system in open market conditions, show the existing electricity market architecture, explain the roles and behaviours of different market participants (manufacturers, customers, transmission and distribution companies) in different market conditions.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.explain the basic concepts of engineering economics and the electricity market 2.compare investment operating and maintenance costs, investment costs and fuel costs for different kinds of power plants as well as analyse levelised costs of electricity (LCOE) of different power plants technology 3.evaluate different methods for a cost benefit analysis in a power system 4.compare the role of different market participants (generating companies, suppliers, traders, transmission and distribution system operators, etc.) on a theoretical and practical level 5.make a simulation of the exploitation of market power in an electricity market 6.eEvaluate different methods for congestion management	
1.4. Course content	
Introduction to engineering economics (interest rate calculation, cost theory and investment cost estimation). The cost of electricity production (conventional and renewables) and the actual cost of electricity production. Cost-effective features of the transmission and distribution network components. Introduction to the Electricity Market (the economic basis of the electricity market, types of market contracts, deregulation and restructuring of the power sector, market participants). Electricity market architecture - theoretical models (bilateral and pool model, auxiliary services market) and practical performances (NordPool, EEX, PJM). Transmission and distribution network under market conditions - transmission and distribution tariffs, different models of transmission (TSO, ITO, NTSO) and distribution companies, transmission network management in case of congestion. Market power - perfect and imperfect competition markets, monopolies and oligopolies, market share indexes (market share, HHI), indexes for market participants' behavior (Lerner index), tools for analysis and simulation of market forces. The legal framework of the electricity market in the Republic of Croatia and the EU - overview of legal and legal acts of the Republic of Croatia and the EU (directives and decrees).	
1.5. Teaching methods	Lecture Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises	1	1,2,3,4,5,6	Lectures, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	4,5,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	10	20
Oral exam	1.5	1,2,4,6	Oral exam	Assessment of student's answers	25	50
Seminar paper (project)	1.5	3,4,5,6	Seminar paper (project)	Evaluation of a project assignment	15	30

1.10. Obligatory literature

1. Nikolovski, S; Fekete G;. Knežević i Z. Stanić. Uvod u tržište električne energije. Osijek: ETFOS, 2010.
2. Kirschen, D.S; Strbac, G. Fundamentals of Power System Economic. John Wiley & Sons, 2004.

1.11. Recommended additional literature

1. M. Shahidehpour, H. Yaminand Z. Li, Market Operationsin Electric Power System – Forecasting, Scheduling and Risk Management, John Wiley & Sons, Inc., New York, 2002
2. M. Greer, Electricity cost modeling calculations, Elsevier, Burlington USA, 2011.
3. S. Stoft, Power System Economics – Designing Markets for Electricity, IEEE/Wiley, 2002

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. ŠLJIVAC DAMIR	
Course name	DE2-01 Power Plants	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students to the basics of energy conversion in power plants, as well as elements and working principles of different types of power plants.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.specify energy processes in power plants 2.estimate basic characteristics of power plants 3.specify hydro powerplant elements and an entity 4.specify thermal powerplant elements and an entity 5.specify nuclear powerplant elements and an entity 6.compare alternative energy sources 7.evaluate electric energy sources in planning and constructing	
1.4. Course content	
Classification of energy forms. Transformation of energy forms. Basic power plant characteristics. Hydro power plants. Parts of hydro power plants. Hydro turbines. Types of hydro power plants. Hydro power plant characteristics. Hydro power plant adjustment to the load. Reversible hydro power plants. Hydro power plants on tide and ebb. Thermal power plants. Steam boiler. Condensing power plants. Cost of thermal plant construction. Combined production of steam and electrical energy. Thermal power plants adjustment to the load. Thermal plants with gas turbines. Nuclear power plants: Basic schemes for steam generation in nuclear power plants. Chain reaction. Fission cross section. Nuclear reactor. Multiplication factor. Reactivity of the reactor. Types of thermal reactors. Breeder reactor. Nuclear fuel cycle. Alternative energy sources: utilisation of solar, geothermal and wind energy. Electrical schemes of power plants. Power plant consumption.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1.3	1,2,3,4,5,6	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	2.5	2,3,4,5,6	Midterm exam	Evaluation of (written) exercises	20	40
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	3,4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	5	10
Oral exam	2.2	1,2,3,4,5,6,7	Oral exam	Assessment of student's answers	25	50

1.10. Obligatory literature

1. Nag, P.K. Power Plant Engineering, 4th edition. McGraph Hill Education, 2014.
2. L. Jozsa: Energetski procesi i elektrane, ETF Osijek, 2006

1.11. Recommended additional literature

1. D. M. Tagare: Electric Power Generation, John Wiley & Sons, Inc., Hoboken/New Jersey, 2011
2. P. Breeze: Power Generation Technologies, Elsevier Newnes, New York, 2005
3. A. K. Raja, A. P. Srivastava, M. Dwivedi: Power Plant Engineering, New Age Publishers, New Delhi, 2006
4. Tehnička enciklopedija, knjige 3, 4 i 5, Leksikografski zavod Miroslav Krleža, Zagreb, 1963 – 1997

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv.prof.dr.sc. HEDERIĆ ŽELJKO, Prof.dr.sc. ERCEG GORISLAV	
Course name	DEc2-02 Electric Drives	
Study program	Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students to the basic types of drives, their properties and characteristics. Students will be presented methods of calculation and selection of the drive system for a specific application. Finally, students will be introduced to modelling and simulating the drives on a computer (virtual laboratory).	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.critically analyse dynamical models of drive systems 2.create models of a separately excited DC motor in the Matlab software package 3.critically analyse the simulation results of electric drive control 4.design an electric drive according to process requirements 5.apply the industrial drive tools to set the parameters of an electric drive 6.evaluate scalar and vector control of asynchronous motors 7.understand and recognise the types of information and communication systems in automated electric drives	
1.4. Course content	
Automation of electric drives. Information and communication systems for electric drives. Typical controls for electric drives. DC motor drive with variable voltage control. AC-DC and DC-DC converters. AC drives with variable frequency and voltage control. AC-AC converters. Servo drives. Servo motors and stepping motors. Mechatronic systems. High dynamic using Motion Control. Motion Control applications. Automation of technical processes using bus systems for connecting measure, control and drive technique. Electric drives simulating using software package MATLAB-Simulink and its tool part SimPowerSystems.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment	
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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	2.5	1,2,3,4	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	1.5	2,5,6,7	Midterm exam	Evaluation of (written) exercises	18	36
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	2,6,7	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	12	24
Oral exam	2	1,2,3,4	Oral exam	Assessment of student's answers	20	40

1.10. Obligatory literature

1. Bose, B. K. Modern Power Electronics and AC Drives, Prenice Hal, 2002.
2. Jurković, B., Elektromotorni pogoni, Školska knjiga, Zagreb, 1990.
3. Skalicki, Božidar, Elektrotehnika u strojarstvu: elektromotorni pogoni, Zagreb,FESB, 1976

1.11. Recommended additional literature

1. Krause, P.C, Wasyinczuk, O. Analysis of Electric Machinery and Drives, IEEE Press, 2002.
2. Werner, Leonhard, Control of electrical drives, Springer-Verlag, Berlin, 2001

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv.prof.dr.sc. HEDERIĆ ŽELJKO	
Course name	DE1-01 Electrical Machines	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	6
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description
1.1. Goals
Explain the working principles of electric machines, construction elements and operating states. Explain the basic analysis of individual electrical machines in different working regimes. Explain the basic state diagnostic procedures and condition monitoring of electrical machines implemented in electrical drives. Train students to conduct simple calculations and analyses of basic electrical machine parameters for different load conditions of asynchronous, DC and synchronous machines. Train them to conduct measuring and testing procedures for synchronous and DC motors, synchronous and DC generators. Train students to conduct calculations of all values obtained by these measurements and to analyse them.
1.2. Conditions for enrollment
Requirements met for enrolling in the study programme
1.3. Learning outcomes
1.explain the working principles, construction parts, the role of transformers in the electric power system, and identify the basic operating states (no load, short circuit, operation under load) 2.explain the working principles, construction parts, role of DC, asynchronous and synchronous machines and drives. Identify the basic operating states (no load, short circuit, operation under load) 3.evaluate the procedures for status diagnostics and results of monitoring the operation of electrical machines in plants 4.explain the calculated values for voltages, currents, power and efficiency for different loads of asynchronous, DC and synchronous machines 5.critically analyse solutions obtained for selected numerical examples of electrical machines 6.categorise and differentiate measurement and testing procedures of asynchronous and DC motors, synchronous and DC generators as well as explain and analyse calculated sizes obtained by these measurements
1.4. Course content
Magnetic systems. Transformers. Basic principles of electrical machines. Synchronous machines. The synchronous machine in a solid network. Torque characteristics. The synchronous machine in the off-grid system. Synchronous motor types and properties. Asynchronous machines. The torque characteristics. The wound rotor induction motor. The squirrel cage induction motor. Skin effect in the deep bar & double cage induction motor. Motor protection principles and design types. Direct current machines. Types of excitation. The reaction of the armature. Characteristics of a generator and motor. Voltage and speed control.

Commutation. Labelling and types of winding. Single-phase machines. Single-phase asynchronous and synchronous motors. Universal motor. Special types of machines. Linear motors. Stepper motors.

1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1.5	1,2,3	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	1	1,2,3,4,5	Midterm exam	Evaluation of (written) exercises	5	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	2	2,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	15	30
Oral exam	1.5	1,2,3,4,5,6	Oral exam	Assessment of student's answers	30	60

1.10. Obligatory literature

1. Pužar, M; Mandić, I. Osnove električnih strojeva. Osijek, 2010.
2. Fitzgerald, E. C; Kingsley; S. D. Umans. Electric Machinery. McGraw-Hill, 2012.
3. Dolenc A.: Transformatori, Školska knjiga, Zagreb, 1991
4. Wolf, R., Osnove električnih strojeva, Školska knjiga, Zagreb 1991.

1.11. Recommended additional literature

1. Piotrovskij, L.M., Električni strojevi, Tehnička knjiga, Zagreb 1970.
2. Bego, V., Mjerni transformatori, TE/8 JLZ, Zagreb 1982.
3. Sirotić, Z., Maljković, Z.,Sinkroni strojevi, skripta ETF Zagreb, 1996.
4. Mandić,Tomljenović,Pužar: Sinkroni i asinkroni električni strojevi, Tehničko veleučilište Zagreb 2012

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. KNEŽEVIĆ GORAN, Prof.dr.sc. BAUS ZORAN	
Course name	DEab1c3-03 Electric Power Substations	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Explain to students the elements of a power plant. Allow students to design, maintain and manage electric power substation.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme, elective modules DE1, DE2. Requirements met for enrolling in the second year of the study programme, elective module DE3	
1.3. Learning outcomes	
1.compare the basic schemes of power substations 2.categorise the elements of a power substation 3.describe subsystems of an electric power substation 4.plan the operation and maintenance of a power substation 5.calculate short circuit current and forces acting on elements of a power substation 6.design an earthling system of an electric power substation 7.choose the elements of an electric power substation according to the current-voltage stresses, forces acting on the elements and thermal stresses	
1.4. Course content	
Basic concepts related to power switching substations. Substation structure: main (primary) and auxiliary (secondary) substation. Basic substation schemes. Substation classifications. Voltage stresses and insulation co-ordination. Overvoltage arresters - selection and location. Current stresses. Short circuit current in the electric power substation. Calculation of thermal stress. Calculation of forces acting on substation elements. Electric power substation elements (bus and conductors, insulators, power cables, switches, disconnectors, middle voltage fuses, current transformers, voltage transformers, power transformers, short-circuit current limiter). Schemes, dispositions and construction of the electric power substation. Grounding in the electric power substation. Lightning protection in the electric power substation. Reliability calculation of electric power substations.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	2	1,2,3,4	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	2	5,7	Midterm exam	Evaluation of (written) exercises	25	50
Writing pre-lab write-ups, results analysis and writing laboratory reports	0.5	5,6,7	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	0
Oral exam	2.5	1,2,3,4,7	Oral exam	Assessment of student's answers	25	50

1.10. Obligatory literature

1. McDonald, J. D. Electric Power Substations Engineering. CRC Press, Third Edition, 2012.
2. H. Požar, Visokonaponska rasklopna postrojenja, Tehnička knjiga - Zagreb, 1967.

1.11. Recommended additional literature

1. B. Belin, Uvod u teoriju električnih sklopnih aparata, Školska knjiga-Zagreb, 1987.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv. prof. dr. sc. MARIĆ PREDRAG	
Course name	DEa1-04-17 Power Transformers	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description	
1.1. Goals	
Explain the working principle of a power transformer and the basic principles of designing and selecting a power transformer. Explain the calculation and simulations of characteristic variables in stationary and transient states.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.describe the working principle (electromagnetic theory), design and operation types of power transformers 2.understand and apply an equivalent scheme and a vector diagram of a power transformer 3.understand and apply the basic principles of power transformer designing 4.make a calculation of power transformer nominal values, allowed heating and variables in different transient states 5.calculate and simulate variables in stationary and transient states using simulation interfaces 6.analyse transformer energisation, remanent flux, high order harmonics in dependence of an iron core type and a vector group	
1.4. Course content	
Working principles of power transformers, application of the electromagnetic theory, inductance and the dynamic inductance, flux linkage, energy of two magnetically coupled circuits, magnetic scalar and vector potential, magnetic dipole moment, Maxwell equations. The ideal and the perfect transformer, flux leakage, no-load current, harmonic analysis of no-load current. Iron core losses, initial magnetisation curve, hysteresis loop, remanent flux, saturation level, analysis of transformer energisation current. Copper losses, impedance voltage, Kapp regulation diagram, equivalent scheme and vector diagram of a power transformer in different operational states. Design types, vector groups, heat transfer, operational types, winding life cycle. Voltage regulation, parallel operation. Protection principle of a power transformer. Basic designing principles. High order harmonics, the third harmonic issue in dependence of a vector group and an iron core type.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment	

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	2	1,2,3,4,5,6	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	1.2	1,2,3,4	Midterm exam	Evaluation of (written) exercises	25	50
Writing pre-lab write-ups, results analysis and writing laboratory reports	0.2	2,3,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	3	6
Oral exam	1.6	1,2,3,6	Oral exam	Assessment of student's answers	22	44

1.10. Obligatory literature

1. A. Dolenc, Transformatori I i II dio, Sveučilišna naklada, Zagreb, 1991
2. James H. Harlow, Electric Power Transformer Engineering - Third Edition, CRC Press, Taylor & Francis Group, 2012.

1.11. Recommended additional literature

1. H. Požar, Visokonaponska rasklopna postrojenja, Tehnička knjiga Zagreb, 1990
2. B. Mitraković, Transformatori, Naučna knjiga, Beograd, 1985.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. NIKOLOVSKI SRETE	
Course name	DE4I-11 Power Lines	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (elective) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (elective) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(15+0+15)+0

1. Course description
1.1. Goals
Provide students with practical knowledge from the field of mechanical and electrical calculations of transmission power lines. Students will learn about electrical characteristics and parameters of overhead power lines and underground cables. Students will obtain knowledge to calculate and choose the cross section of transmission line conductors, their mechanical and electrical characteristics. Students will acquire skills to work with software for computation of voltage drops, electrical losses, voltage and current conditions on overhead and cable lines. Also, students will acquire skills for the calculation of transfer voltage through cable armature.
1.2. Conditions for enrollment
Requirements met for enrolling in the study programme
1.3. Learning outcomes
1.understand mechanical and electrical characteristics of overhead lines 2.compute and evaluate the values of electrical parameters for overhead lines and cables 3.design and evaluate an overhead line with all mechanical and electrical characteristics 4.create overhead and cable networks using a software tool and check the selection of cross sections according to voltage drops and short circuit criteria 5.evaluate the calculations for the coefficient of transfer potential for cables which connect transformer station grounding systems
1.4. Course content
Introduction. Overhead lines. Conductors of overhead lines (material, construction, dimensions). Mechanical computation of conductors, mechanical load capacity, forces which act on conductors, well-flow equation of transmission line states, proper state related to the stress and sags, loading caused by the wind force, conductors and grounding wire placement on the tower, and security distances. Isolation of lines (material, insulator features, the choice of insulators). Accessories for overhead lines (connection accessories, protection accessories). Towers (material and construction, type of towers, sizing, and foundations). Grounding of transmission lines (grounding resistance and grounding systems, step and touch voltage, function of grounding wires). Cable lines. Conductors for cables (material, construction and sizing). Types of cables. Parameters of overhead and cable lines (resistance, conductance, capacitance and conductance) and their calculation using GMD method. Selecting the cross sections of cables (voltage drop computation, thermal computation, short circuit computation). Layout of the cables and cable

accessories (air, grounding, water). Types of grounding of cable networks. Transfer potential computation in cable networks.

1.5. Teaching methods	Lecture Auditory exercises Construction exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	**ECTS**	**Learning outcomes**	**Teaching method**	**Assessment method**	**Points**	
					Min	**max**
Attendance Lectures, Auditory exercises, Design exercises	2	1,2,3,4,5	Lectures, Auditory exercises, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	2	5
Practice – problem solving	1	3,4	Midterm exam	Evaluation of (written) exercises	15	30
Oral exam	1	1,2,3,4,5	Oral exam	Assessment of student's answers	18	35
Problem-solving related to design exercises	1	2,3,4,5	Design exercises	Evaluation of problem solving exercises	11	30

1.10. Obligatory literature

1. L. Jozsa: Nadzemni vodovi, ETF Osijek, 2011.
2. L. Jozsa: parametri nadzemnih vodova, ETF Osijek 2005
3. V. Srb, Kabelska tehnika, priručnik, Tehnička knjiga, Zagreb, 1970

1.11. Recommended additional literature

1. Mirošević, G.; Vidaković, F.: Projektiranje, gradnja i održavanje dalekovoda, KIGEN d.o.o., Zagreb, 2008.
2. William A. Thue: Electrical Power Cable Engineering, Third Edition, CRC Press, 2017

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv. prof. dr.sc. KLAIĆ ZVONIMIR, Izv.prof.dr.sc. PELIN DENIS	
Course name	DEc1-04 Electromagnetic Compatibility	
Study program	Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	45+(0+15+0)+0

1. Course description	
1.1. Goals	
Familiarise students with the basic knowledge in the field of electromagnetic compatibility for the purpose of designing protection of unwanted influences of electromagnetic variables on electric networks, devices and living organisms.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.explain and describe voltage quality indices, their causes and consequences as well as the methods for improvement 2.estimate harmful feedback influences of power electronic converters (PEC) and loads on a utility grid 3.evaluate procedures for obtaining AC characteristics of the basic PEC and specific loads 4.compare and apply international and European standards for power quality; define and apply the Grid code of a power system 5.describe the sources (causes) of interferences caused by the VF field radiation 6.evaluate the measured radiation patterns of different antennas	
1.4. Course content	
The basic terms. Non-ideal properties of components, wiring, mechanical switches. Low-frequency interference. Asymmetry of voltages and harmonics, reactive power. Grounding, saftey-grounding, single-point grounding compared to multipoint ground, ground loops. AC characteristics of power electronic converters (PEC) and non-linear loads connected to them. The influence of power electronic converter (PEC) on the utility grid and loads. Air -disturbance: symmetrical and asymmetrical currents described on the example of two parallel conductors, procedures for mitigation of sensitivity. Crosstalks: causes, shielded cables, twisted pair cables. Shielding: radiation protection, protection against high-frequency magnetic fields.	
1.5. Teaching methods	Lecture Laboratory exercises
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. Course assessment	
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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises	1	1,2,4,6	Lectures, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	1,3,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	20	20
Oral exam	1.5	1,2,4,5,6	Oral exam	Assessment of student's answers	20	40
Individual work	1	2,4,5	Individuall work	Evaluation of the seminar paper a presentation of the paper	0	20
Team work	0.5	2,3	Team work	Team work evaluation. Evalution of students' answers.	0	10

1.10. Obligatory literature

1. Tokić, A; Milardić, M. Kvalitet električne energije. Tuzla: PrintCom, 2015.
2. I. Flegar: Elektronički energetski pretvarači, Kigen, Zagreb, 2010.
3. Z. Klaić: Mjerenje i analiza kvalitete električne energije u distribucijskoj mreži prema EN 50160, magistarski rad, Osijek 2006.

1.11. Recommended additional literature

1. P.R.Clayton: Introduction to Electromagnetic compatibility, John Willey &Sons, 2006.
2. EURELECTRIC: Power Quality in European Electricity Supply Networks, Brussels, 2002.
3. Ph. Feracci: Cahier Technique no. 199 – Power Quality, Schneider Electric, 2001.
4. R.F. Harrington, Time-harmonic electromagnetic fields, McGraw-Hill, New York, 1961.
5. J. Bartolić, Mikrovalna elektronika, Graphis, Zagreb, 2009.
6. I. Flegar: Elektromagnetska kompatibilnost; Niskofrekvencijsko područje; Skripta, ETF Osijek,2003.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv.prof.dr.sc. MILIČEVIĆ KRUNO	
Course name	DEc1-05 Electrical and Magnetic Measurements	
Study program	Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Familiarise students with the skills for correct measuring of electrical and magnetic magnitudes. Interpret measurement instruments specifications in order to estimate uncertainty, reliability and cost and the need for maintenance and calibration. Introduce students to simple automated metering systems.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.interpret and compare the features of various measuring devices for electrical and magnetic measurements in practice 2.detect irregularities and interference that may affect the measurement result in practice and take measures to reduce them to an acceptable level 3.set a measurement concept for the implementation of accurate, repeatable, simple and complex measurements in practice 4.select the appropriate measuring method, measuring and test equipment that meets the requirements and the budget of the task, carry out the measurement, i.e. test procedure in practice 5.apply knowledge in the implementation of the electricity quality measurement and high-voltage testing 6.apply acquired skills when collecting, storing, and validating measurement data, manually or with the help of computers, as well as presenting them and making reports commonly used in practice	
1.4. Course content	
Selection of optimal measurement instruments for specific purpose. Testing. Voltmeters, ammeters, ohmmeters, watt meters, power analysers, watt-hour meters, analogue and digital oscilloscopes, logic analysers, digital counters, spectrum analysers, recorders, measurement bridges, compensators, multi-meters. PC based automated measuring systems. Advanced measurement methods of electric quantities (current, voltage, frequency, phase displacement, apparent power, active power, reactive power, power factor, active energy, reactive energy, resistance, inductance, mutual inductance, capacitance, dissipation factor, impedance and admittance, magnetic and electric fields). Noise, interference, minimizing interference. Conventional and unconventional measurement transformers. Measurement of electric energy quality. High voltage measurements and testing. Magnetic measurements - measurements of magnetic induction and magnitude of magnetic field. Measurements of characteristics of magnetic materials (magnetisation curve, hysteresis loops, permeability, magnetisation losses).	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	2	1,2,3,4,5	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	3	10
Practice – problem solving	1	1,2,4	Midterm exam	Evaluation of (written) exercises	15	30
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	1,2,5,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	16	30
Oral exam	1	1,2,3,4,5	Oral exam	Assessment of student's answers	15	30

1.10. Obligatory literature

1. Bego, V. Mjerenja u elektrotehnici. Zagreb: Graphis, 2003. ISBN: 953-6647-46-X
2. Morris, Alan S. Measurement and Instrumentation: Theory and Application. Butterworth-Heinemann; 1 edition (September 26, 2011)
3. Z. Godec, D. Dorić.- Osnove mjerenja, laboratorijske vježbe / 5. izd.-Osijek 2007.
4. A. Šantić, Elektronička instrumentacija, Školska knjiga, 1993.

1.11. Recommended additional literature

1. D. Vujević, B. Ferković, Osnove elektrotehničkih mjerenja I II, Školska knjiga, Zagreb, 1996.
2. R. Malarić, Instrumentation and measurement in electrical engineering, BrownWalker Press 2011.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv. prof.dr.sc. RUPČIĆ SLAVKO	
Course name	DK1-01 Electromagnetic fields and waves	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students with the laws of generating electromagnetic fields and generating and spreading electromagnetic waves. Present the procedures for analysing problems in electromagnetism.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.express Maxwell equations in differential and integral form and explain them in the simplest examples 2.apply Maxwel equations to calculate fields for different configurations and dynamics of charge changes in conductive and dielectric environments 3.apply Poynting's theorem and calculate Poynting's vector for EM wave propagation problems 4.calculate the components of the flat wave electric and magnetic field at its arrival at the border - applying the boundary conditions 5.analyse linear dipole antenna radiation 6.evaluate the measured radiation patterns of different antennas	
1.4. Course content	
Fundamentals of physics incorporated in the electrical engineering with the description of EM fields. Fundamentals of EM field laws. Maxwell's equations. Boundary conditions. Poynting's theorem, Poynting's vector and the flow of power. The vector and scalar EM potentials. Electrostatic field. The method of images and variable separation. Electrostatic currents. Bio-Savart's law, Inductance and mutual inductance. Introduction of EM wave theory. Plane wave characteristics, reflection and dispersion, dispersion modes, energy density, polarization. Plane wave in the dispersive material. Dispersion of EM waves in free space.. Helmholtz's equation. Hertz's vector. Basic dipole. Radiation of linear antennas. Influence of nonionizing radiation on living organisms.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
1.6. Comments	Classes can be taught in a foreign language (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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1	1,2,3,4,5,6	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	2	5
Practice – problem solving	3.5	2,3,4,5	Midterm exam	Evaluation of (written) exercises	23	45
Writing pre-lab write-ups, results analysis and writing laboratory reports	1.5	2,4,5,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	10	20
Oral exam	1	1,2,3,4,5	Oral exam	Assessment of student's answers	15	30

1.10. Obligatory literature

1. Bartolić, J. Mikrovalna elektronika. Zagreb: Graphic, 2012.
2. Balanis,C.A. Advanced Engineering Electromagnetics, 2nd Edition. Wiley, 2012.

1.11. Recommended additional literature

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. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. SLIŠKOVIĆ DRAŽEN, Doc.dr.sc. KESER TOMISLAV	
Course name	DER4I-05-17 Elements of Automation	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (elective) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (elective) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(0+30+0)+0

1. Course description
1.1. Goals
Present the basic principles of automation system and process management mechanisms. Familiarise students with the basic building blocks of a control circuit, teach them to identify and define the tasks of particular parts of the control circuit, and to select and define the requirements to the needs of the managed process. Show them the types and explain the purpose of measuring and actuating control parts, as well as their technical-technological characteristics. Explain to them the physical principles of measuring and generating process variables, processing of measurement signals and reduction of measurement uncertainty and interference. Present the types and topologies of industrial communication networks. Familiarise them with types and applications of industrial computers and embedded computer systems of special purpose and functionality.
1.2. Conditions for enrollment
Requirements met for enrolling in the second year of the study programme
1.3. Learning outcomes
1.to define the role of measuring and actuator devices and other equipment for the realization of the automated control system 2.to select the type and characteristics of the measuring and actuator devices in accordance with the requirements of the specific control task 3.evaluate and select industrial computer components for process control and supervision needs 4.evaluate and select a suitable drive for an electric motor and connect it with a process computer 5.make a simple user programme for a selected process computer 6.design a simple control system based on embedded or industrial computer systems
1.4. Course content
Measurement of process variables: distance, position, angle of rotation, thickness, rotation speed, force, torque, level, pressure, flow, temperature, pH value and other process sizes. Technologies for transferring measurement signals. Types of interference and their sources. Measurement errors. Signal processing. Measuring devices in automatic control systems. Executing devices: DC, AC and AC motors, pneumatic, electropneumatic, hydraulic and electrohydraulic devices, pumps, compressors and valves. Thyristor and transistor inverters. Static and dynamic characteristics of measuring and control devices. Intelligent measuring and executive devices. Input and output units and interfaces in measurement and control devices. Process computers, design and programming. Industrial communication and management organisation. Built-in computer systems.

1.5. Teaching methods	Lecture Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises	2	1,2,3,4,5,6	Lectures, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	2	5
Writing pre-lab write-ups, results analysis and writing laboratory reports	0.5	3,4,5,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	15	30
Oral exam	0.2	1,2,3,4	Oral exam	Assessment of student's answers	15	30
Written exam	1.3	1,2,3,4,5,6	Presenting a seminar paper	Project review and evaluation	15	30
Project presentation	0.5	2,3,4,6	Course report.	Project evaluation	2	5

1.10. Obligatory literature

1. Clarence W. de Silva. Sensors and Actuators: Engineering System Instrumentation, Second Edition. CRC Press 2015, ISBN 9781466506817
2. J. Tomac, Osnove automatske regulacije - Elementi automatike â€ predavanja, ETF, Osijek, 2008.

1.11. Recommended additional literature

1. M. Jadrić, B. Frančić, Dinamika električnih strojeva, Sveučilište u Splitu, Graphis Zagreb, 1995.
2. B. K. Bose, Modern Power Electronics and AC Drives, Prentice Hall, Upper Saddle River, USA, 2002.
3. A. Parr, Hydraulics and Pneumatics - A technician's and engineer's guide, second edition, Elsevier Ltd, Velika Britanija, 1998.
4. Z. Kovačić, S. Bogdan, Elementi automatizacije procesa - predavanja, FER, Zagreb.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. GLAVAŠ HRVOJE	
Course name	DEb1-04 Energy Efficiency	
Study program	Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students to the meaning of energy efficiency and its historical development. Based on the classification of specific areas of energy efficiency analysis, a detailed analysis of each area will be performed. The detailed analysis includes: construction as the largest sector of primary energy consumption, transport sector and public lighting. Once acquired, attention is paid to energy balance and problems that arise from energy efficiency improvement. On the example of lighting, the paradox of increased consumption due to increased efficiency is analysed.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.explain and describe the concept of energy efficiency 2.analyse areas for the implementation of energy efficiency measures 3.analyse energy balance 4.create a methodological framework for Jevonson's paradox analysis 5.create a proposal for optimal energy efficiency improvement measures	
1.4. Course content	
Energy efficiency is a way to achieve energy independence. The course analyses energy efficiency measures through the following: the efficiency of primary energy conversion, conversion efficiency of direct consumption and energy conservation through reduced consumption. Energy audits, using primary energy factors, determine primary energy demands of each consumer. It presents EU legal frameworks and recommendations related to energy efficiency. Practical use of the acquired knowledge is carried out through an individual energy auditing project of housing spaces and energy efficiency labelling.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment	
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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	2	1,2,3,4,5	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Practice – problem solving	1	3	Midterm exam	Evaluation of (written) exercises	10	20
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	3	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	20
Oral exam	1	1,2,3,4,5	Oral exam	Assessment of student's answers	25	50

1.10. Obligatory literature

1. Energijski audit – 1. dio: Opći zahtjevi (EN 16247-1:2012)

1.11. Recommended additional literature

1. Directive 2006/32/Ec Of The European Parliament And Of The Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC
2. Directive 2002/91/Ec Of The European Parliament And Of The Council of 16 December 2002 on the energy performance of buildings
3. UNDP, Priručnik za energetske savjetnike, Zagreb, 2008.
4. Ministarstvo zaštite okoliša, prostornog uređenja i graditeljstva, metodologija provođenja energetskog pregleda zgrada, Zagreb, 2009.
5. Energy Management Handbook, seventh edition, CRC press, 2009.
6. Zakon o energetskoj učinkovitosti NN127/14
7. Direktiva o energetskoj učinkovitosti 2012/27/EU

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. TOPIĆ DANIJEL	
Course name	DEB1-06-17 Energy Efficiency of Electrical Systems	
Study program	Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students to measures taken for energy efficiency improvement in electrical systems. Introduce students to measures for energy efficiency improvement in industrial systems. Present measures for energy efficiency improvement in the power system. Present measures for energy efficiency improvement of electric drives. Present measures for energy efficiency improvement in lighting systems.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.make categorisation of electrical systems 2.describe measures of energy efficiency 3.make suggestion for energy efficiency measures 4.compare energy savings achieved with different measures of energy efficiency	
1.4. Course content	
Legislation related to energy efficiency. Introduction of energy efficiency measures in electrical systems. Energy efficiency of the industry. Measures for the improvement of energy efficiency of electrical systems in the industry. Energy efficiency of power system. Measures for the improvement of energy efficiency in power systems. Energy efficiency of electric drives. Measures for the improvement of energy efficiency in electric drives. Energy efficiency of lighting. Measures for the improvement of energy efficiency in lighting systems. Compensation of reactive power. Energy management systems.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment	
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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1	1,2,3,4	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Practice – problem solving	1.5	4	Midterm exam	Evaluation of (written) exercises	15	30
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	2,3,4	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	10
Oral exam	1.5	1,2,3,4	Oral exam	Assessment of student's answers	25	50

1.10. Obligatory literature

1. Sumper, A. ;Baggini, A. Electrical energy efficiency: Technologies and application. Wiley, 2012.
2. UNDP- Priručnik za energetske savjetnike. Zagreb, 2008.

1.11. Recommended additional literature

1. Energy Management Handbook, seventh edition, CRC press, 2009
2. Guidebook on Energy Efficient Electric Lighting for Buildings, L. Halonen, E. Tetri, P. Bhusal, International Energy Agency, 2010.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. GLAVAŠ HRVOJE	
Course name	DE4I-02 Energy Audits and Public Lighting	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (elective) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (elective) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(0+15+15)+0

1. Course description	
1.1. Goals	
Introduce students to energy audits by focusing on energy audits of public lighting. By carrying out detailed analysis of certain methodology items, the objective of the course is to expand the knowledge about the implementation of energy auditing of public lighting by taking its specificity into account. Furthermore, the course provides basic information on public lighting design in order to propose realistic energy efficiency measures.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.explain and describe the process of energy auditing 2.understand the functioning of the basic elements of a public lighting system 3.analyze the data collected and create a report on energy auditing 4.create a proposal for technical solutions for improving energy efficiency 5.create solutions for improving energy efficiency	
1.4. Course content	
Energy reviews are an integral part of the implementation of part of the European Union's energy policy. The aim of the course is to familiarize students with the process of implementing the energy auditing of public lighting through the analysis of the energy balance in accordance with the national methodology. For the purposes of analysis it is necessary to adopt basic knowledge of basic elements and design of public lighting so that it can propose technical solutions to improve energy efficiency and select the optimal solutions for improving energy efficiency.	
1.5. Teaching methods	Lecture Laboratory exercises Construction exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises, Design exercises	2	1,2,3,4,5	Lectures, Laboratory exercises, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	3	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	20
Oral exam	1	1,2,3,4,5	Oral exam	Assessment of student's answers	25	50
Problem-solving related to design exercises	1	2,3,4	Design exercises	Evaluation of problem solving exercises	0	20

1.10. Obligatory literature

1. EN 13201-1 Cestovna rasvjeta -- 1. dio: Odabir razreda rasvjete
2. EN 13201-2 Cestovna rasvjeta -- 2. dio: Zahtijevana svojstva
3. EN 13201-3 Cestovna rasvjeta -- 3. dio: Proračun svojstava
4. EN 13201-4 Cestovna rasvjeta -- 4. dio: Metode mjerenja svojstava rasvjete
5. EN 13201-5 Cestovna rasvjeta -- 5. dio: Pokazatelji energetskih svojstava

1.11. Recommended additional literature

1. Zakonu o energiji (NN 68/01, 177/04, 76/07)
2. Zakonom o Fondu za zaštitu okoliša i energetsku učinkovitost (NN107/03)
3. Zakon o prostornom uređenju i gradnji (NN 76/07)
4. Energy Management Handbook, seventh edition, CRC press, 2009.
5. Svjetlotehnički priručnik, Elektrokovina, Maribor, 1978.
6. UNDP, Priručnik za energetske savjetnike, Zagreb, 2008.
7. Ministarstvo zaštite okoliša, prostornog urešenja i graditeljstva, metodologija provođenja energetskog pregleda zgrada, Zagreb, 2009.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. SLIŠKOVIĆ DRAŽEN	
Course name	DRb3Ec1-03 Industrial Informatics	
Study program	Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	30+(15+30+0)+0

1. Course description
1.1. Goals
Familiarise students with production system control tasks, and the implementation method of an automatic process control system, starting from the technical process level, over control systems to supervisory systems and the production process as a whole. Present the application of PLCs, SCADA systems and industrial communication systems, which form the basis for a practical implementation of automatic control of various processes.
1.2. Conditions for enrollment
Requirements met for enrolling in the second year of the study programme
1.3. Learning outcomes
1.describe the control methods of complex technical (production) systems, and explain informatization and automation of production systems 2.describe the structure and working principles of a process computer and its realisation as a programmable logic controller 3.select PLC configuration and write controlling/user programme for simple and complex exercises 4.explain the advantages and disadvantages of (de)centralisation in the implementation of a process automation system 5.describe the role and structure of SCADA and its main interfaces 6.define the requirements for the communication system at different control levels, and choose a suitable communcation method for a specific purpose 7.establish communication (with several communication standards) using Simatic equipment
1.4. Course content
Manufacturing system and an industrial plant. Control processes and stratification of control assignments. Informatisation and automatisation of a manufacturing system. Basic structure of automatic control processes. Practical examples. Measurement and process value displaying system. Automatic control system. Digital realisation of a controller. Process computer and a programmable logic controller. Linking a process computer with a process. Control unit – a central unit for an automatic control process. Structures of a processing unit: central and non-central, hierarchical and distributive. Regulatory unit – a subsystem for communication of an operator-manufacturing system and a process database. Structural regulatory units and the ways of providing services of a current automatisation system. Process and regulatory unit equipment. Communication systems for industrial application. Portable technologies/general purpose standards as the basis for the majority of industrial communication standards. Communication technologies on the level of fields and higher controlling levels. Specialised networks for programmable logic controllers. Software support in automatisation systems. User programming tools. Examples of systems for controlling and automatisation of manufacturing processes and supervision of an automatic manufacturing process. Information related to designing and maintaining automatisation systems.

1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	**ECTS**	**Learning outcomes**	**Teaching method**	**Assessment method**	**Points**	
					Min	**max**
Attendance Lectures, Auditory exercises, Laboratory exercises	2.5	1,2,3,4,5,6,7	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	2	5
Practice – problem solving	1.3	3,4,5,6	Midterm exam	Evaluation of (written) exercises	15	30
Writing pre-lab write-ups, results analysis and writing laboratory reports	1.7	3,5,6,7	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	12	30
Oral exam	1.5	1,2,4,5,6	Oral exam	Assessment of student's answers	18	35

1.10. Obligatory literature

1. Slišković, D., Procesna automatizacija – predavanja, ETFOS, Osijek, 2009.
2. Perić, N., Automatizacija postrojenja i procesa - predavanja, FER, Zagreb, 2000.

1.11. Recommended additional literature

1. Smiljanić, G., Računala i procesi, Školska knjiga, Zagreb, 1991.
2. Jović, F., Kompjutersko vođenje procesa, Zveza organizacij za tehničko kulturo Slovenije, Ljubljana, 1988.
3. Crispin, A. J., Programmable Logic Controllers and their Engineering Applications, McGraw-Hill Publishing Company, 1997.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	lzv.prof.dr.sc. MILIČEVIĆ KRUNO	
Course name	DEc2-05 Industrial Measurements	
Study program	Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	6
	Workload (L+(AE+LE+CE)+S)	30+(0+15+15)+0

1. Course description	
1.1. Goals	
Students are introduced to the specifics of process signals and measurements in the industrial environment, techniques of conversion of process variables into electrical signals to gain better understanding of measurement procedures as part of automated processes. Present to students the possibilities of selecting a process measurement instrument regarding the requirements of accuracy, reliability and cost, maintenance and calibration requirements. Present software applications for collecting, processing and displaying process measurement data.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.identify the specificities of measurements in the industry 2.define measurement methods and devices regarding specifications of an industry plant 3.classify the measuring sensors by type and their performance 4.name the methods for measurement signals processing and their transformation into digital format, and technologies for transmission of measurement signals 5.identify interference that occur in the industrial environment and define protection measures 6.select the type and characteristics of measuring sensors and measuring devices for a specific process measurement task	
1.4. Course content	
Special conditions for technical systems in industrial plants including energy and technological facilities. Signalling and measurement. Behaviour of measurement signals. Behaviour of measuring devices. Standard measurement signals, HART protocol. Sensors: active and passive sensors, tensors. Electrodynamic, piezoelectric, thermodynamic, photoelectric, magnetic and chemical sensors. Measurements supported by a computer. A/D converters, measuring hardware and software in the industry, and PLC and SCADA display as measurement tools. Collecting, processing, and displaying measurement data using the LabVIEW software package. Process instrumentation: measuring methods and sensors for measuring (pressure, levels, flow, temperature and humidity). Process analytics: measuring procedures and systems for gas and liquid analysis. Measurement of other process variables. Complex measuring systems in automated process plants. Local and telemetric measurement systems in the industry. Increasing reliability (high tolerance) and safety in industrial measurements. Measuring equipment in explosive zones. Selection of appropriate equipment in industrial measurements.	
1.5. Teaching methods	Lecture Laboratory exercises Construction exercises

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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises, Design exercises	1.5	1,2,3,4,5	Lectures, Laboratory exercises, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	2	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	1,2,3,4,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	12	20
Oral exam	1.5	1,2,3,4,5	Oral exam	Assessment of student's answers	15	30
Problem-solving related to design exercises	1.5	2,5,6	Design exercises	Evaluation of problem solving exercises	10	20
Individual tutorials during office hours	0.5	2,5,6	Individual meetings with students	Grading a seminar paper	10	20

1.10. Obligatory literature

1. Valter, Z. Procesna mjerenja. Osijek: Elektrotehnički fakultet, 2008. ISBN 978-953-6032-59-4
2. A. Šantić, Elektronička instrumentacija, Školska knjiga, 1993.
3. MORRIS A.S; LANGARI R. Measurement and Instrumentation-Theory and Application. Elsevier, Academic Press, 2012, ISBN 978-0-12-381960-4

1.11. Recommended additional literature

1. D. Vujević, B. Ferković, Osnove elektrotehničkih mjerenja I II, Školska knjiga, Zagreb, 1996.
2. R. Malarić, Instrumentation and measurement in electrical engineering, BrownWalker Press 2011.
3. V. Bego, Mjerenja u elektrotehnici, Školska knjiga, Zagreb, 1990.
4. Thomas Stauss, Flow Handbook, 3rd Edition, Endress+Hauser Flowtech AG, Reinach, 2006.
5. Donald R. Gillum, Industrial Pressure, Level and Density Measurement 2nd edition, ISA – Instrumentation, Systems and Automation Society, 2009.
6. Omega, Transactions in Measurement and Control: Volume 2 Data Acquisition, Putman Publishing Company and OMEGA Press LLC, 1998.
7. Omega, Transactions in Measurement and Control: Volume 3 Pressure, Putman Publishing Company and OMEGA Press LLC, 1998.
8. Omega, Transactions in Measurement and Control: Volume 4 Flow and Level, Putman Publishing Company and OMEGA Press LLC, 1998.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. ŠLJIVAC DAMIR, Izv. prof. dr.sc. KLAIĆ ZVONIMIR	
Course name	DEb3-03 Integration of Renewable Energy Sources and Smart Grids	
Study program	Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(0+15+0)+0

1. Course description	
1.1. Goals	
Introduce students to the influence of distributed generation from RES to current-voltage conditions in a power network, and the concepts and application of smart grids.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.identify valid legal regulation for RES integration 2.define the influence of distributed RES production on power flows, short circuit current, electrical power quality and protection selectivity 3.explain the term of smart metering and determine possible applications 4.explain the basic concepts and a design of a smart grid and microgrid, interpret modes of microgrid management and operation and compare smart grids and conventional ones 5.perform smart metering, manage consumption, and integrate RES into the smart grid in simple examples	
1.4. Course content	
Legislative regulation for the integration of renewable energy sources into a power grid. Influence of distributed RES generation on power flows, short circuit current, power quality and selectivity of protection. Smart measurement and application. Concept and design of smart grids and micro grids. Control and operation of micro grids. Load management. Integration of RES into smart grids. Advantages of smart grids and micro grids compared to conventional networks.	
1.5. Teaching methods	Lecture Laboratory exercises
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. Course assessment	
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 the students' work during the semester and on the final exam	

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises	1.5	1,2,3,4,5	Lectures, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	2	2,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	20
Oral exam	2	1,2,3,4	Oral exam	Assessment of student's answers	25	50
Seminar paper	1.5	2,3,4	Individuall work	Grading a seminar paper	0	20

1.10. Obligatory literature

1. Bollen, M.H.J; Hassan, F. Integration of Distributed Generation in the Power System. Wiley, 2011.

1.11. Recommended additional literature

1. Microgrids, Arhitectures and Control, Nikos Hadziargyriou, IEEE Press, Wiley, 2014.
2. Understanding Power Quality Problems, Math H.J. Bollen, IEEE Press, Wiley, 2000.
3. Tokovi snaga u mreži, Lajos Jozsa, Skripta ETF Osijek
4. Kratki spojevi, Lajos Jozsa, Skripta ETF Osijek
5. Wind Power in Power System, Thomas Ackermann, Wiley, 2007.
6. HRN EN 50160:2012, Naponske karakteristike električne energije iz javnog distribucijskog sustava
7. Važeća zakonska regulativa za integraciju OIE u RH

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. BALEN JOSIP	
Course name	DA4R4I-10 Intelligent Transportation Systems	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (elective) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(0+30+0)+0

1. Course description	
1.1. Goals	
Introduce students to the field of intelligent transport systems with an emphasis on VANETs (Vehicular Ad-hoc Networks). Teach and train students to develop, implement and evaluate algorithms for efficient information dissemination among vehicles and infrastructure in VANETs.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.identify basic principles and challenges in Intelligent Transport Systems 2.explain the benefits of new technologies embedded in vehicles and transportation infrastructure 3.analyse, compare and evaluate various information dissemination approaches in VANETs 4.develop and implement algorithms for message dissemination in VANETs 5.conduct algorithm test by using traffic and network simulators 6.collect measurement results and evaluate the performance	
1.4. Course content	
Introduction to basic principles and challenges in intelligent transport systems. Intelligent roads and traffic infrastructure. Overview of new technologies built into vehicles (architecture, embedded systems, operating systems, communication devices). Autonomous driverless vehicles. Information dissemination in VANETs (applications, concepts). Safety of communication, vehicles and pedestrians. Algorithms and protocols for efficient information dissemination among vehicles. Simulation of traffic and communication between vehicles and infrastructure using Omnet ++, Veins and SUMO simulators. Processing obtained results and performance evaluation.	
1.5. Teaching methods	Lecture Laboratory exercises
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. Course assessment	

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises	0.8	1,2,3,4,5,6	Lectures, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	4	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	5,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	25
Oral exam	1	1,2,3,4	Oral exam	Assessment of student's answers	18	35
Solving a project task	2.2	1,2,3,4,5,6	Team work and programming solution development	Questions based on a presented project assignment	20	30

1.10. Obligatory literature

1. Sommer, C; Dressler, F. Vehicular Networking. Cambridge University Press, 2014.
2. Bošnjak, I. INTELIGENTNI TRANSPORTNI SUSTAVI - ITS 1. Zagreb: Fakultet prometnih znanosti, Sveučilište u Zagrebu, 2006.

1.11. Recommended additional literature

1. S. Ghosh, T. S. Lee, Intelligent Transportation Systems: Smart and Green Infrastructure Design, Second Edition, CRC Press, 2010
2. R. Popescu-Zeletin, I. Radusch, M. Rigani: Vehicular-2-X Communication: State-of-the-Art and Research in Mobile Vehicular Ad hoc Networks. Springer, 2010
3. 3. M. Picone, S. Busanelli, M. Amoretti, F. Zanichelli, G. Ferrari, Advanced Technologies for Intelligent Transportation Systems, Springer, 2014
4. J. Balen, Učinkovito rasprostiranje poruka u mrežama vozila zasnovano na njihovom položaju, doktorska disertacija, Osijek, Elektrotehnički fakultet, 2014.
5. C. Sommer, F. Dressler, Progressing Toward Realistic Mobility Models in VANET Simulations, IEEE Communications Magazine, vol. 46 (11), pp. 132-137, studeni 2008.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. JOB JOSIP, Doc.dr.sc. GRBIĆ RATKO	
Course name	DRdKb3-03 Internet of Things	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	30+(0+15+15)+0

1. Course description	
1.1. Goals	
Familiarise students with basic theoretical knowledge and practical skills in the field of the Internet of Things and enable them to work both independently and in teams on the projects of collecting, storing, processing and visualising the data in accordance with the Internet of Things paradigm.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.evaluate and explain the elements' appropriateness of the given IoT system 2.evaluate the tool appropriateness for developing a programming code of a microcontroller system in a specific project 3.develop a custom software solution by using appropriate libraries for more than one sensor in a microcontroller system 4.to propose the design of the IoT system for the given simple problem 5.apply the theoretical basis for making a simple system in the Internet of Things	
1.4. Course content	
Introduction to the Internet of Things (IoT). IoT technologies (elements, circuits, communication, platforms and development environments). IoT architecture and infrastructure. Collecting and storing data (mechanisms, protocols, applications and services). Data access (real-time, on-demand, publish/subscribe). User interfaces and data visualisation. Application of Internet facilities: industry, meteorology, agriculture, medicine, smart homes, smart cities.	
1.5. Teaching methods	Lecture Laboratory exercises Construction exercises
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. Course assessment	
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 the students' work during the semester and on the final exam	

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises, Design exercises	1	1	Lectures, Laboratory exercises, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	0.5	2	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	10
Oral exam	0.5	4	Oral exam	Assessment of student's answers	20	40
Problem-solving related to design exercises	0.5	3	Design exercises	Evaluation of problem solving exercises	0	10
Seminar paper	2	5	Presenting a seminar paper	Presentation of a seminar paper	0	30

1.10. Obligatory literature

1. Bahga, A; Madisetti V. Internet of Things: A Hands-on-Approach, Arshdeep Bahga & Vijay Madisetti, 2014.

1.11. Recommended additional literature

1. Dieter Uckelmann, Mark Harrison, Florian Michahelles, Architecting the Internet of Things, Springer, 2011.
2. Charalampos Doukas, Building Internet of Things with the Arduino: 1, CreateSpace Independent Publishing Platform, 2012.
3. H. Zhou, The Internet of Things in the Cloud: A Middleware Perspective, Boca Raton, CRC Press, 2012.
4. A. McEwen, Hakim Cassimally, Designing the Internet of Things, John Wiley & Sons, 2013.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv. prof. dr. sc. NENADIĆ KREŠIMIR	
Course name	DRcdKb2-02 Internet Programming	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students to working principles of internet access services and development of these technologies over time. Introduce how an HTTP protocol and service works, and present the levels of protection. Give an overview of modern client and server technologies which enable us to develop dynamic and modern web/internet pages.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.explain the communication between web browsers and servers, compare different web technologies and approaches to website creation 2.compare different technologies and use them in web document developing 3.identify the client and server technologies and select the appropriate technology to create a specific task in the form of a website 4.choose the appropriate way to access a database over the web, develop your own website-based solution as well as server and client functionality into a complete project 5.analyse and solve a specific problem, combine different technologies in developing web applications and predict possible application improvements	
1.4. Course content	
Internet fundamentals and development. Network addressing and naming of computers, URL, DNS servers. Basics of network programming: client-server and other models, system support for networking. Main network services (telnet, ftp, www) and protocols (TCP/IP). Internet access: SLIP, PPP. World wide web: fundamentals, browsers, searching. Internet security: intruders and protection. Design of www documents. Client-side technologies: HTML (syntax, standard structure, hypertext, forms), cascade styles, JavaScript, JavaScript and HTML, JavaScript dynamic documents, Java Applets, XML, DHTML. Server-side technologies: CGI, servers, PHP, ASP and ASP.NET, cookies. Web access to data (PHP/SQL). Web portals. Web design and application examples.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	2.5	1,2,3,4,5	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	6	10
Practice – problem solving	1.7	2,3,4,5	Midterm exam	Evaluation of (written) exercises	15	30
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	2,3,4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	15	20
Oral exam	1.8	1,2,3,4	Oral exam	Assessment of student's answers	20	40

1.10. Obligatory literature

1. Lukić, Ivica; Köhler, Mirko. Osnove Internet programiranja, 2011.
2. Sebesta, R.W. Programming the World Wide Web (2nd Ed.). Addison-Wesley, Boston, MA, 2004.

1.11. Recommended additional literature

1. T. Powell, Thomas, Web Design: The Complete Reference. Berkeley, Osborne/McGraw-Hill, NY, 2000.
2. M. Hall, L. Brown; Core Web programming, A Sun Microsystems Press/Prentice Hall PTR Book, New York, NY, 2001.
3. K. Kalata, Internet Programming, Thompson Learning, London, 2001.
4. F. Halsall, Computer Networking and the Internet (5th Ed.), Addison-Wesley, Boston, MA, 2005.
5. H. Deitel, P. Deitel, T. Nieto, K. Steinbuhler, The Complete Wireless Internet and Mobile Business Programming Training Course, Prentice Hall, New York, NY, 2003.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. ŽAGAR DRAGO	
Course name	DKb1-05 Codes and Coding	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Familiarise students with issues of optimal and error control coding of information. Explain limit possibilities of protecting data from transmission errors. Present basic and advanced techniques of error control coding aimed at choosing the optimal coding method in given communication conditions.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.explain and describe the basic principles of communication and processing of source information 2.evaluate and apply rules of optimal coding of an information source 3.construct optimal security codes for given conditions of information transmission 4.design algebraic methods and shift registers for constructing a coder and decoder of linear error control codes 5.select the appropriate error control code according to modern communication network requirements achieving proper efficiency as well as an expected error correction rate	
1.4. Course content	
Communication and processing. Source information coding. Optimal coding. Basic theorem of coding. Shannon-Fano method for optimal coding. Huffman code. Arithmetical coding. LZ algorithm. LZW algorithm. Error control coding. Binary symmetric channel capacity. Possible and impossible coding area. Burst errors. Interleaving. Perfect codes. The use of algebra in data protection. Block codes. Parity check codes: single bit parity, rectangular code, repetition code, repetition code with parity. Hamming codes. Binary linear codes. Cyclic codes. Shift register application in coding and decoding. Bose-Chaudhury-Hocquenghem code. Peterson-Gorenstein-Zierler decoder. Reed-Solomon codes. Convolutional codes. Viterbi decoder. Turbo codes and their properties. LDPC codes. Coding efficiency. The applications of error control codes in computing and communications.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment	

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1.5	1,2,3,4,5	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	1	4
Practice – problem solving	1	2,3,4,5	Midterm exam	Evaluation of (written) exercises	16	32
Writing pre-lab write-ups, results analysis and writing laboratory reports	2	2,3,4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	12	24
Oral exam	1.5	1,2,3,4	Oral exam	Assessment of student's answers	15	30
Writing a seminar paper supervised by a teacher	1	2,3,4,5	Consultation for seminar paper drafting.	Grading a seminar paper and results presentation	6	10

1.10. Obligatory literature

1. Pandžić, I.S i ostali. Uvod u teoriju informacije i kodiranje. Zagreb:Element, 2007.
2. Gravano S. Introduction to Error Control Codes. Oxford University Press, Oxford, 2001.

1.11. Recommended additional literature

1. M. Purser, Introduction to Error-Correcting Codes, Artech House, Boston-London, 1995.
2. N. Rožić, Informacija i komunikacije, kodiranje s primjenama, Alinea, Zagreb 1992.
3. I.S. Pandžić et al, Uvod u teoriju informacije i kodiranje, Element Zagreb, 2009.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. ŽAGAR DRAGO	
Course name	DKb3-02 Communication Protocols	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Familiarise students with methods and procedures for communication protocols design. Explain basics and applications of Petri net in communication protocol design. Explain protocol mechanisms for control and signalisation in communication networks.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.describe and explain protocol architecture of modern communication networks 2.estimate and compare methods and tools for formal specification, verification and validation of communication protocols 3.plan tools and methods for the analysis and synthesis of communication protocols 4.evaluate different approaches in solving communication problems on individual layers within layered protocol model 5.evaluate mechanisms and control protocols in modern communication networks as well as appropriate protocol solutions	
1.4. Course content	
Communication network architectures. Protocols and protocol architecture. Structural protocol design. Phases of protocol design. Formal and semi-formal methods. Protocol specification. Protocol verification. Protocol implementation. Protocol testing. Perturbation technique. Tools for communication protocols analyses and synthesis. Petri net structure and implementation. Petri nets communication protocols modelling. Petri nets modelling of services. SPIN and Promela. Protocol simulators. Layered protocol development. OSI model. Hierarchical design, DoD model. Local networks and protocols. Routing protocols. Reservation protocols, RSVP protocol for resource reservation. IP protocol and internetworking. IPv6 protocol, new perspectives and problems introducing new protocol. Control protocols. Transport protocols. Application protocols. Mobile network protocols. Signalisation protocols. Signalisation for functions of call and service processing. Conceptual model of intelligent network. CAS (R2), CCS. SS7 protocol and OSI model. H.248, BICC, SIP-T, SIP-I. Session initiation protocol. Session description protocol SDP. Network management protocols.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1.3	1,2,3,4,5	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	1	4
Practice – problem solving	1.7	2,3,4	Midterm exam	Evaluation of (written) exercises	16	32
Writing pre-lab write-ups, results analysis and writing laboratory reports	1.3	2,3,4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	12	24
Oral exam	2	1,2,3,4,5	Oral exam	Assessment of student's answers	15	30
Seminar paper	0.7	3,4,5	Consultation for seminar paper drafting.	Grading a seminar paper and results presentation	6	10

1.10. Obligatory literature

1. Lovrek, I. Modeli telekomunikacijskih procesa - teorija i primjena Petrijeve mreže. Zagreb: Školska knjiga, 1997.
2. Tanenbaum, A. S; D. J. Wetherall. Computer Networks-5. izdanje. Prentice Hall, Boston, 2011.

1.11. Recommended additional literature

1. A. Bažant, et al, Osnovne arhitekture mreža, Element Zagreb, 2014.
2. W. Stallings, Data and Computer Communications, Tenth Edition, Macmillan Publishing Company, New York, 2014
3. Gerard J. Holzmann, Design and Validation of Computer Protocols, Prantice Hall, New Jersey, 1991.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. NIKOLOVSKI SRETE	
Course name	DEa3-03 Protection coordination of active electical networks	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory)	
Course status	Mandatory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description	
1.1. Goals	
Capacitate students for by itself model,simulate and design complex systems of protection system in electrical networks with distributed generation (DG)	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.describe and understand the types of grounding in networks which are different in the case of nonexisting and existing distribution generation 2.analyse the issues of anti-islanding protection of distributed generations using voltage and frequency protection devices 3.create the model of a network and protection devices in networks with distributed generations 4.evaluate the values of fault currents and analyse them from the aspect of protection devices functions 5.create and design a model network using computer software and make protection coordination according to the speed, selectivity and redundance of numerical relays 6.evaluate different principles of active protection for distributed generations	
1.4. Course content	
The basic topology of active el. networks and fault currents distribution in such networks. The features of ungrounded-isolated network, network with resistive grounded and grounding with resonance inductor. The principes of work of currents, voltages, frequencies, directionals protections in networks with isolated and resitive qrounding with small resistor or resonance inductor grounding. Characteristics of currents phase and grounding faults numerical relays, which are used in isolated networks, their time current characteristics. The feature sof voltages, frequencies and power relays will be explained in detail and all therie settings for distributed generations in the network. Characteristics of different protections for all types od DG (PV, wind generators and biomass and biogas power plants) and their characterictic protections. The probelem of AR -automatic reclosing and its influence on relays settings for anti islanding protection. Parameters of pasive principe protection of voltage U<, U>, frequency f>, f<, and relays with voltage vector shift Δθ>, rate of chane of frequency ROCOF (df/dt>). Active principe of anti islanding protection , the method of impedance measuring, the method of injected carrier frequency, communication sheme , WAMS system protection, trawelling wawe method, with sampe cases. Using of software for coordination and simulation of numerical protection devices for parametrisation and protection relays coordination for networks with distribuded generators, radial sheme and double feeded line.	
1.5. Teaching methods	Lecture Auditory exercises

	Laboratory exercises
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. Course assessment	
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 the students' work during the semester and on the final exam	

Student's activity	**ECTS**	**Learning outcomes**	**Teaching method**	**Assessment method**	**Points**	
					Min	**max**
Attendance Lectures, Auditory exercises, Laboratory exercises	1.5	1,2,3,4,5,6	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Practice – problem solving	1.5	4,5	Midterm exam	Evaluation of (written) exercises	10	20
Writing pre-lab write-ups, results analysis and writing laboratory reports	2	5,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	20
Oral exam	2	1,2,3,4,5,6	Oral exam	Assessment of student's answers	25	50

1.10. Obligatory literature

1. Srete Nikolovski Zaštita u EES-u, ETF Osijek 2007.
2. Protection of Power Systems with Distributed Generation, ETH, Eidgenössische Technische Hochschule Zürich, EEH Power Systems Laboratory, 2005.

1.11. Recommended additional literature

1. Protection of Distribution Systems with Distributed Energy Resources, CIGRE, CIRED, Final report 2015
2. Network protection and automation Guide, AREVA , priručnik 2011
3. P.M. Anderson Power system protection IEEE Press series, New York, 1999

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv. prof. dr.sc. KLAIĆ ZVONIMIR, Prof.dr.sc. NIKOLOVSKI SRETE	
Course name	DEa2-05 Quality and Reliability in Electric Power Systems	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	6
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students to voltage quality standards, voltage quality parameters, power quality analysis and applications in the power system. Introduce students to probability distributions of voltage events in the power system, reliability indicators of distribution and transmission networks.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.compare international and European standards for power quality and the Grid code of a power system 2.explain and describe voltage quality indices, their causes and consequences and the methods for improvement 3.interpret the stochastic assessment of the annual number of voltage dips due to short circuits in the part of a power system and the cost of voltage dips in an industrial facility 4.evaluate and interpret the results of measuring and monitoring of the power quality 5.apply probability density functions of stohastical process in an electric power system 6.understand the reliability and availability indices of transmission and distribution networks 7.develop the models for reliability indices computation using software for transmission and a distribution network analysis	
1.4. Course content	
Voltage quality standards, voltage quality parameters: voltage variations and flicker, voltage dips and interruptions, voltage swells and overvoltage, harmonics, voltage imbalance. Analysis of power quality measurements and monitoring results. Stochastic evaluation of voltage dips due to short circuits in a power system. Economic effects of a poor power quality. Impact of renewable sources on a power quality. Power quality in smart grids. Probability distribution of the power system operating states (Markov model states of space and probability, frequency and duration of breaks for serial, parallel and mixed component connections). Conditions for operation, repair, disconnection, generator states and consumption states relay. Reliability indicators, reliability indicators distribution networks.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1	1,2,3,4,5,6,7	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Practice – problem solving	1	3,5,6	Midterm exam	Evaluation of (written) exercises	10	20
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	3	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	20
Oral exam	2	1,2,6	Oral exam	Assessment of student's answers	15	30
Project presentation	1	1,2,5,7	Project presentation	Evaluation of reliability analysis results	0	20

1.10. Obligatory literature

1. Tokić, A; Milardić, V. Kvalitet električne energije. PrintCom Tuzla, 2015.
2. Chowdhury, Ali ; Don Kova. Power Distribution System Reliability: Practical Methods and Applications.
3. I. Baggini, A. Handbook of Power Quality. John Wiley & Sons Ltd, 2008.
4. Zvonimir Klaić: Mjerenje i analiza kvalitete električne energije u distribucijskoj mreži prema EN 50160, magistarski rad, Osijek 2006.

1.11. Recommended additional literature

1. HRN EN 50160:2012, Naponske karakteristike električne energije iz javnog distribucijskog sustava
2. IEEE std 1159-1995 – IEEE Recommended Practice for Monitoring Electric Power Quality, IEEE Standards Board, 1995
3. EURELECTRIC: Power Quality in European Electricity Supply Networks, Brussels, 2002.
4. Ph. Feracci: Cahier Technique no. 199 – Power Quality, Schneider Electric, 2001.
5. V. Mikuličić, Z- Šimić Modeli pouzdanosti i raspoloživosti i rizika u EES-u I dio Kigen, 2008
6. R. BillintonR.N: Allan Reliability Assesment of Large Electric Power Systems Kluwer Academic Publisher 1988
7. Math H.J. Bollen, Understanding Power Quality Problems, IEEE Press, Wiley, 2000.
8. Srete Nikolovski Analiza pouzdanosti EES.a - Skripta ETF Osijek 1995

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv.prof.dr.sc. CRNJAC-MILIĆ DOMINIKA	
Course name	D4-01 Management	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory) Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	4
	Workload (L+(AE+LE+CE)+S)	30+(15+0+0)+0

1. Course description
1.1. Goals
Students will get acquainted with all elements of enterprise management. In this way, they will be ready to work in the economy, develop conceptual skills more easily when pursuing self-employment, or stand out as quality employees in company management or an organisational unit.
1.2. Conditions for enrollment
Requirements met for enrolling in the second year of the study programme
1.3. Learning outcomes
1.define and explain basic management functions 2.determine basic management skills and their importance for managers 3.suggest organisational management approaches to a company based on acquired knowledge 4.assess the appropriateness of an organisational structure for the enterprise 5.analyze skills that help managers to become successful 6.compare leadership and management
1.4. Course content
Introduction and development of the management theory, contemporary trends in the management theory and practice, management ethics, corporate social responsibility management, business planning, prediction, decision making, nature of an organisation, formation of an organisational structure and organisation promotion, strategy concept, strategic management and strategy levels, development of a strategic plan, strategic project management, selection and recruitment of personnel, training and development of personnel, communication and communication skills important for successful management, work motivation, compensation management (compensation for work performed, compensation from profit share, managerial compensation), control, information technology and management, business intelligence, management skills, category management.

1.5. Teaching methods	Lecture Auditory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises	1.3	1,2,3,4,5,6	Lectures, Auditory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Practice – problem solving	0.7	4,5	Midterm exam	Evaluation of (written) exercises	5	10
Oral exam	1	1,2,3,4,5,6	Oral exam	Assessment of student's answers	25	50
Seminar paper	0.5	1,2,5	Studying literature related to the subject of seminar work and writing seminar work. teamwork.	According to the guidelines for writing a seminar work, grading the content and style of a seminar paper	0	15
Creating a ppt presentation and exposing the topic of seminar work.	0.5	1,2,5	According to instructions given by the teacher, students prepare a presentation on a given seminar paper topic, while simultaneously following the content of the previously written paper.	After presenting a seminar paper, the teacher grades the activity by assigning points	0	15

1.10. Obligatory literature

1. Buble, Marin. Management. Ekonomski fakultet Split, Split, 2008.
2. Z. Lacković, Management elektrotehničkih djelatnosti, Elektrotehnički fakultet Osijek, Osijek,2008.
3. P. Sikavica, F. Bahtijarević-Ĺ iber, N. Pološki Vokić,Temelji menadžmenta, Sveučilište u Zagrebu, Ĺ kolska knjiga, Zagreb,2008

1.11. Recommended additional literature

1. Caroselli M., Vještine vodstva za menadžere, Mate d.o.o., Zagreb, 2014.
2. Cohen S. P., Vještine pregovaranja za menadžere, Mate d.o.o., Zagreb 2014.
3. P. Kotler, K. L. Keller, M. Martinović, Upravljanje marketingom, 14. Izdanje, Mate d.o.o., Zagreb 2014.
4. Buble M., Klepić Z., Menadžment malih poduzeća: Osnove poduzetništva, Ekonomski fakultet Sveučilišta, Mostar, 2007.
5. Certo S., Certo T., Moderni menadžment, Mate d.o.o., Zagreb, 2008.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of

the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. VINKO DAVOR	
Course name	DKa1-05 Microelectronics	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	30+(0+15+30)+0

1. Course description	
1.1. Goals	
Introduce students to technological bases for the implementation of microelectronic circuits. Present the basic skills of designing analogue and digital circuits using a given technology. Introduce students to project implementation: from technical requirements, circuit design to test methods for an integrated circuit.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.define technological bases for realization of microelectronic circuits 2.design basic analogue and digital circuits in the given technology 3.develop subcircuits of a project assignment 4.integrate sub-circuits of the project task into a functional unit 5.evaluate the performance of a project assignment circuit	
1.4. Course content	
Integrated circuits production technologies: planar silicon technology, hybrid thin and thick film technology. Components of bipolar and unipolar integrated circuits: transistors, diodes, resistors, capacitors. Digital bipolar and unipolar integrated circuits: current switch, basic gates of TTL, ECL, I2L, NMOS and CMOS families. Analogue bipolar and unipolar integrated circuits: constant current stages, referent voltage stages, DC voltage level shift stages, basic stages of amplification (CE, CS), differential amplifier', operational amplifiers architectures. Techniques of integrated circuits design: PLD, GA, StC, FC. Design principles of complex microelectronic analogue and digital circuits: amplifiers, comparators, A/D and D/A converters, filters, wave-shape generators. DFT – design for testability methods in an integrated circuit. Introduction to nanotechnology.	
1.5. Teaching methods	Lecture Laboratory exercises Construction exercises
1.6. Comments	Classes can be taught in a foreign language (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. Course assessment	

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises, Design exercises	1.3	1,2,3,4	Lectures, Laboratory exercises, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	5	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	1.5	2,3	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	18	18
Oral exam	2.2	1,2	Oral exam	Assessment of student's answers	25	50
Problem-solving related to design exercises	2	3,4,5	Design exercises	Evaluation of problem solving exercises	17	22

1.10. Obligatory literature

1. Švedek, T. Osnove mikroelektronike. Osijek: Elektrotehnički fakultet Osijek, 2002.
2. Weste, N.H.E; Harris D. CMOS VLSI design - a circuits and systems perspective. Pearson Education, 2005.
3. P. Biljanović, Mikroelektronika, Školska knjiga, Zagreb, 1983.

1.11. Recommended additional literature

1. N. H. E. West, D. Harris, CMOS VLSI Design, Third edition, Pearson Education, Inc., 2005.
2. A. S.Sedra, K.C.SMith, Microelectronic Circuits, 3.Edition, Saunders College Publishing, New York, 1991.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. RIMAC-DRLJE SNJEŽANA	
Course name	DK3-01 Mobile communications	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description
1.1. Goals
Introduce students to features of radio signal propagation in mobile communication systems, cellular system features, antenna base station components, and solutions in 2G, 3G and 4G systems. Enable students to apply steady-state knowledge to the calculation of signal coverage and traffics in a given cell, select the appropriate base station antenna system components, select the parameters of a particular mobile system, measure the electrical field strength, and evaluate results according to applicable standards and regulations.
1.2. Conditions for enrollment
Requirements met for enrolling in the second year of the study programme
1.3. Learning outcomes
1.compare radio channel models and explain the choice of frequency for uplink and downlink, intermodulation, Doppler effect as well as multipath propagation in mobile communication 2.compare different propagation models and calculate signal coverage for indoor and outdoor radio wave propagation 3.compare characteristics of macrocells, microcells and picocells and calculate traffic for a specific cell type 4.analyse characteristics of a base station antenna system and compare appropriate components according to technical specifications 5.compare the concept and architecture, physical and logical channels, call setup, modulation and coding as well as handover in GSM and UMTS networks 6.explain the concept and architecture of LTE 7.measure the electric field strength and evaluate measured values from the aspect of fast and slow signal changes, signal coverage and limit values according to the applicable norms and regulations
1.4. Course content
Evolution of mobile communication systems; differences between the first, second and third generation. Mobile communication channel; channel models. Different propagation cases, path loss calculation, multi-path fading, interference, intermodulation, Doppler shift; propagation models. Cellular concept. Macro-cells, micro-cells and pico-cells. Traffic calculation. Indoors propagation. Antenna base station system. Mobile phone antennas. Concept and architecture of GSM, GPRS and EDGE. Concepts and architecture of 3G and 4G networks: physical and logical channels, call setup, transmitter power control, adaptive modulation and coding, call handover. RAKE receiver. Integration of voice and data services. Wireless local area networks. Protection against nonionising electromagnetic fields.

1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	**ECTS**	**Learning outcomes**	**Teaching method**	**Assessment method**	**Points**	
					Min	**max**
Attendance Lectures, Auditory exercises, Laboratory exercises	1.5	1,2,3,4,5,6,7	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	3	5
Practice – problem solving	2.2	1,2,3,4	Midterm exam	Evaluation of (written) exercises	18	35
Writing pre-lab write-ups, results analysis and writing laboratory reports	0.8	1,2,4,5,7	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	4	10
Oral exam	2.5	1,2,3,4,5,6,7	Oral exam	Assessment of student's answers	25	50

1.10. Obligatory literature

1. Bažant, A i ostali. Osnove arhitekture mreža. Zagreb: Element, 2004.
2. Molisch, A. F. Wireless Communications, 2nd edition. John Wiley&Sons, 2010.

1.11. Recommended additional literature

1. M. J. Hernando, F. Perez-Fontan, Introduction to Mobile Communications Engineering, Artech House, 1999.
2. S. Rimac-Drlje, Mobilne komunikacije, priručnik za laboratorijske vježbe, zavodska skripta, 2010.
3. E. Zentner, Antene i radiosustavi, Školska knjiga, Zagreb, 2001.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. TOPIĆ DANIJEL	
Course name	DE4I-03 Modeling and Control of Renewable Power Systems	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (elective) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (elective) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students with modelling and control of the renewable energy power plants. Present to students mathematical and computer models of the solar power plants. Present to students mathematical and computer models of the wind power plants. Present to students mathematical and computer models of the hydro power plants. Present to students mathematical and computer models of the geothermal and biomass power plants.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.identify and distinguish renewable power plants 2.categorise technical properties of renewable energy power plants 3.design a mathematical model of a renewable energy power plant 4.plan the working principle and manage renewable energy power plants	
1.4. Course content	
Basic characteristics of the renewable energy power plants. Modelling of solar power plants. Modelling of wind power plants. Modelling of hydro power plants. Modelling of biomass power plants. Modelling of geothermal power plants. Control of solar, wind, hydro, geothermal and biomass power plants.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment	
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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1	1,2,3,4	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Practice – problem solving	1	3	Midterm exam	Evaluation of (written) exercises	13	25
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	3,4	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	20
Oral exam	2	1,2,3	Oral exam	Assessment of student's answers	23	45

1.10. Obligatory literature

1. Modeling and Control of Sustainable Power Systems, Wang, Lingfeng, Springer 2012.
2. Dynamic Modeling, Simulation and Controlof Energy Generation, Vepa, Ranjan, Springer 2013.

1.11. Recommended additional literature

1. Wind Energy Generation:Modelling and Control, Olimpo Anaya-Lara, Nick Jenkins, Janaka Ekanayake, Phill Cartwright, Mike Hughes
2. Design of Smart Power Grid Renewable Energy Systems, Ali Keyhani, Wiley, 2011
3. Renewable energy integration: Practical management of variability, uncertainity and flexibility in power grids, L.E. Jones, Academic Press, 2014.
4. Lingfeng, Modeling and Control of Sustainable Power Systems, Wang, , Springer 2012.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. ŽAGAR DRAGO	
Course name	DK1-02 Computer Networks	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	6
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description
1.1. Goals
Familiarise students with basic and advanced wireline and wireless technologies. Describe the importance of flow and error control in computer networks and introduce the mechanisms for network traffic control. Acquaint students with Quality of Service requirements as well as architectures and mechanisms for QoS acquirement. Teach students to design computer networks parameters in order to optimise network resources and QoS.
1.2. Conditions for enrollment
Requirements met for enrolling in the study programme
1.3. Learning outcomes
1.analyse the advantages and disadvantages of particular network technologies and architectures based on concrete computer network applications 2.project the parameters of a computer network according to application requirements 3.design and application of appropriate network equipment for computer networks interconnection and integration to a global network 4.critically compare the mechanisms and methods for flow and congestion avoidance in computer networks 5.combine and integrate the mechanisms and architectures for Quality of Service achievement for different requirements of recent network applications 6.aapply methods and tools for measurements and optimization of computer network performances
1.4. Course content
Network topologies. Protocol hierarchy. Basics of network traffic control. Basic models for queuing theory. Broadband access in computer networks (xDSL, optics, Ethernet in the first (last) mile, fixed wireline access, WiMAX). Fixed wireline network technologies. Wireless computer networks, IEEE 802.11, IEEE 802.16, Bluetooth, IEEE 802.15.4. Computer networks interconnecting. Spanning tree protocol. Implicit and explicit congestion control. Flow control. Quality of Service QoS, Quality of Experience QoE. QoS applications requirements. The mechanisms for QoS in computer networks: traffic shaping, packet scheduling, access control. Basic architectures for QoS achievement: integrated services model, differentiated services model. MPLS. Hybrid QoS models. Real-time traffic in a computer network. RTP and RTCP protocols. SIP protocol. Computer network management. Computer network design. Performance optimisation in a computer network. Performance measurement. Computer network services. Computer network standardisation.

1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	2	1,2,3,4,5,6	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	1	4
Practice – problem solving	1	2,3,4,6	Midterm exam	Evaluation of (written) exercises	16	32
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	2,3,4,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	12	24
Oral exam	1.5	1,2,4,5,6	Oral exam	Assessment of student's answers	15	30
Seminar paper	0.5	1,2,3,4,5,6	Writing a seminar paper supervised by the teacher	Grading a seminar paper and results presentation	6	10

1.10. Obligatory literature

1. Bažant, A i ostali. Osnovne arhitekture mreža. Zagreb: Element, 2014.
2. Tanenbaum, A. S; Wetherall, D. J. Computer Networks (5. izdanje). Boston: Prentice Hall, 2011.

1.11. Recommended additional literature

1. W. Stallings, Data and Computer Communications, Tenth Edition, Macmillan Publishing Company, New York, 2014.
2. V. Sinković: Informacijske mreže, Školska knjiga, Zagreb, 1994.
3. J. F. Kurose, K. W. Ross: Computer Networking: A Top-Down Approach (6. izdanje), Addison-Wesley, Boston, 2013.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. RIMAC-DRLJE SNJEŽANA	
Course name	DK2-01 Multimedia Systems	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(0+15+15)+0

1. Course description	
1.1. Goals	
Introduce students to methods and international standards for compression of multimedia signals, and train them for their usage in a variety of applications.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.analyse and evaluate compression methods for still images, video and audio and apply one or more methods for lossless compression 2.analyse human video system characteristics as well as algorithms for video coding 3.compare and evaluate results of coding according to JPEG and JPEG2000, MPEG-2, MPEG-4 Visual, H.261, H.263 and H.264 standard 4.develop algorithms for still image and video processing for different applications 5.explain characteristics of a speech signal as well as a human audio system, analyse and evaluate basic algorithms for speech and audio coding 6.elect and apply the appropriate encoders, protocols and parameters for multimedia transmission in different applications	
1.4. Course content	
Introduction: multimedia application areas. Basics of human visual and audio perceptions from the aspect of video and audio compression effects. Presentation of a picture on a computer; colour systems. Digital image formats. Compression methods: entropy coding (Runlength, Huffman, Arithmetic, LZW), predictive coding, transformational coding (FFT, DCT, DWT). Image compression standards: JPEG and JPEG2000. Video digitisation, video compression standards: MPEG-2, MPEG-4 Visual, H.261, H.263, H.264, H.265, SVC. Characteristics and modelling of a speech signal. Algorithms and standards for speech compression. Digitalisation of audio signals, audio encoding. MPEG-7 and MPEG-21 standards. Packet audio and video transmission. Multimedia transmission over broadband networks. Multimedia in mobile communications. Communication protocols for multimedia, quality of services.	
1.5. Teaching methods	Lecture Laboratory exercises Construction exercises
1.6. Comments	Classes can be taught in a foreign language

	(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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises, Design exercises	2.5	1,2,3,4,5,6,7	Lectures, Laboratory exercises, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	5	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	1.2	1,3,4,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	10	20
Oral exam	2	1,2,3,4,6,7	Oral exam	Assessment of student's answers	25	50
Problem-solving related to design exercises	1.3	5,7	Design exercises	Evaluation of problem solving exercises	5	20

1.10. Obligatory literature

1. Li, Ze-Nian ;M.Drew; Mark S., Liu, Jiangchuan. Fundamentals of Multimedia. Springer 2014.
2. S. Rimac-Drlje, M. Vranješ, D. Vranješ: Multimedijski sustavi, priručnik za laboratorijske vježbe, Sveučilište u Osijeku, 2013.

1.11. Recommended additional literature

1. I.E.G. Richardson: H.264 and MPEG-4 video compression, John Wiley & Sons, 2003.
2. R.C. Gonzales, R.E. Woods: Digital Image Processing, Pearson Prentice Hall, New Jersey, 2008.
3. Jans-Reiner Ohm: Multimedia Signal Coding and Transmission (Signals and Communication Technology), Springer, 2015.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv. prof. dr. sc. HERCEG MARIJAN, Doc.dr.sc. JOB JOSIP	
Course name	DAK1-03 Advanced Programming	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(0+15+15)+0

1. Course description	
1.1. Goals	
The aim of the course is to enable students to independently and systematically develop a programming application by using available libraries and mechanisms that programming languages, operating systems and hardware offer. The aim is to develop mental concepts in students to enable understanding of the relationship and dependence between programmes and hardware architecture.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.identify the special features of compilers for a targeted architecture when designing programming applications 2.explain the programming code compilation process 3.assess the efficiency of the memory usage in a code and suggest possible improvements 4.develop a software solution of the given simple task for targeted architecture 5.define and debug errors in dedicated software support while creating the one 6.evaluate operation of a developed software solution	
1.4. Course content	
Tasks of software and its features. Development, debugging and testing of software. C language elements: the size and representation of the basic data types; variables and their representation within the given architecture; memory assignment mechanisms; functions; indicators; structures, unions and address alignment; code compilation. Version control systems. C programming language extensions, special extensions in some C compilers.	
1.5. Teaching methods	Lecture Laboratory exercises Construction exercises
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. Course assessment	

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises, Design exercises	1	1,2,3,4,5,6	Lectures, Laboratory exercises, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	5	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	4,5,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	10	20
Oral exam	2	1,2,3,4,5,6	Oral exam	Assessment of student's answers	25	50
Problem-solving related to design exercises	1	1,4,5,6	Design exercises	Evaluation of problem solving exercises	10	20

1.10. Obligatory literature

1. Šribar, J; Motik, B. Desmistificirani C++, 3. Dopunjeno izdanje, 2010.
2. Heathfield, Richard; Lawrence, Kirby et al. C Unleashed, SAMS, 2000.

1.11. Recommended additional literature

1. C99 language standard, ISO/IEC 9899:TC3, ISO/IEC, 2007.
2. Richard Heathfield, Lawrence Kirby et al, C Unleashed, SAMS, 2000.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. LUKIĆ IVICA	
Course name	DKR4I-03 Advanced Web Programming	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (elective) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(0+30+0)+0

1. Course description	
1.1. Goals	
The aim of the course is to clarify the user interface design process as well as the background application when developing internet applications. Students will get familiarised with complex programme frameworks which are used for developing internet applications, which is a process fundamentally different from the usual application development processes without the use of frameworks. Students will be introduced to newer software frameworks for fast development of high quality and interactive internet applications.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.compare different client side technologies for creating internet applications 2.evaluate different server side technologies for creating internet applications 3.create complex software solutions based on advanced web technologies and services 4.analyse and solve a specific problem, combine different technologies and software frameworks to create a web application	
1.4. Course content	
Access to creating web documents using different technologies and programming frameworks. Introduction to the MVC concept. Client side technologies: HTML (syntax, standard structure, hypertext, forms), Cascading Styles, JavaScript, JavaScript and HTML, dynamic JavaScript documents, jQuery, AngularJS, Bootstrap. Server side technologies: PHP, ASP, and ASP.NET. Access database (PHP/SQL), CakePHP, Zend, Laravel. Creating advanced internet applications and application examples. Part of the course is carried out by independent research work with the basic sources and latest technologies.	
1.5. Teaching methods	Lecture Laboratory exercises
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. Course assessment	
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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises	2	1,2,3	Lectures, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	6	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	2,3,4	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	15	20
Oral exam	1	1,2,3	Oral exam	Assessment of student's answers	20	40
Project	1	2,3,4	Development of web application	Verification of solved tasks	15	30

1.10. Obligatory literature

1. MacIntrye, Peter; Tatroe Kevin; Lerdorf Rasmus. Programiranje PHP treće izdanje. O'Reilly i IT Expert, 2015.
2. Shackelford, Adam. Beginning Amazon Web Services with Node.js. New York: Apress, 2015.
3. R. Delorme, Programming in HTML5 with Javascript and CSS3, Microsoft Press, Redmond Washington, 2014.

1.11. Recommended additional literature

1. L. Revill, jQuery 2.0 Development Cookbook, Published by Packt Publishing Ltd. Livery Place 35 Livery Street Birmingham B3 2PB, UK, 2014.
2. K. Williamson, Learning AngularJS, Published by O'Reilly Media, Inc., 1005 Gravenstein Highway North Sebastopol, CA 95472, 2015.
3. L. Ullman, PHP Advanced and Object-Oriented Programming: Visual QuickPro Guide (3rd Edition), Peachpit Press, 1301 Sansome Street, San Francisco, CA 94111, 2012.
4. R. Nixon, Learning PHP, MySQL & JavaScript With jQuery, CSS & HTML5, O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472, 2014.
5. A. K. Pande, jQuery 2 Recipes, Apress, Apress Media LLC 233 Spring Street New York, NY 10013, 2014.
6. C. Pitt, Pro PHP MVC, Apress, Apress Media LLC 233 Spring Street New York, NY 10013, 2012.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	FERČEC IVANKA	
Course name	D4F-01 German	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (facultative) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (facultative) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (facultative) Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (facultative) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (facultative)	
Course status	Facultative	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	4
	Workload (L+(AE+LE+CE)+S)	30+(30+0+0)+0

1. Course description
1.1. Goals
According to the Common European Framework of Reference for Languages for Level A1 (Basic User – Breakthrough or Beginner), students can understand and use familiar everyday expressions and very basic phrases aimed at the satisfaction of needs of a concrete type, introduce themselves and others, ask and answer questions about personal details (such as where he/she lives, people they know and things they have), interact in a simple way (provided the other person talks slowly and clearly and is prepared to help).
1.2. Conditions for enrollment
None
1.3. Learning outcomes
1.relate the basic concepts used in everyday private and business environments that are thematically related to the topics discussed in the course (introducing oneself, family, activities, food and drink, traffic, travelling, counting) 2.formulate everyday activities in the private and business environments that are thematically related to the topics discussed in the course, and compare the rules of Croatian and German 3.apply new grammar-related knowledge (e.g. Personalpronomen, Possessivartikel, definiter und indefiniter Artikel, Negativartikel, Zahlen, Verb: Präsens, W-Fragen, Ja/Nein Fragen, Perfekt mit sein und haben, Modalverben können, mögen) 4.write simple and short texts thematically related to the topics discussed in the course
1.4. Course content
1. define the basic concepts used in everyday private and business environments that are thematically related to the topics discussed in the course (introducing oneself, family, activities, food and drink, traffic, travelling, counting); 2. describe everyday activities in the private and business environments that are thematically related to the topics discussed in the course, and compare the rules of Croatian and German; 3. apply new grammar-related knowledge (e.g. Personalpronomen, Possessivartikel, definiter und indefiniter Artikel, Negativartikel, Zahlen, Verb: Präsens, W-Fragen, Ja/Nein Fragen, Perfekt mit sein und haben,

Modalverben können, mögen); 4. write simple and short texts thematically related to the topics discussed in the course.

1.5. Teaching methods	Lecture Auditory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	**ECTS**	**Learning outcomes**	**Teaching method**	**Assessment method**	**Points**	
					Min	**max**
Attendance Lectures, Auditory exercises	1.4	1,2,3,4	Lectures, Auditory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	1.2	1,2,3,4	Midterm exam	Evaluation of (written) exercises	25	50
Oral exam	1	1,2,3	Oral exam	Assessment of student's answers	20	40
Homework	0.2	1,2,3,4	Grammar-related exercises/Short essays	Evalution of exercises/Correcting exercises and essays	0	5
Self-participation in classes	0.2	1,2,3,4	Self-initiated participation in teaching in the application of processed language and grammatical structures	Evidence of self-participation in classes/ verification of answers given	0	5

1.10. Obligatory literature

1. Evans, S; Pude, A; F. Specht. Menschen (A 1.1) – Kursbuch. Hueber Verlag GmbH&Co KG, Ismaning, 2012..
2. S. Glas-Peters, A. Pude, M. Reimann. Menschen (A 1.1) – Arbeitsbuch. Hueber Verlag GmbH&Co KG, Ismaning, 2012.

1.11. Recommended additional literature

1. S. Schlüter, Menschen (A 1) - Berufstrainer, Hueber Verlag GmbH&Co KG, München, 2015.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. RUDEC TOMISLAV, Doc.dr.sc. KATIĆ ANITA	
Course name	DKa1-04 Numerical Mathematics	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(30+0+0)+0

1. Course description	
1.1. Goals	
Explain to students the meaning and application of numerical algorithms and methods in electrical engineering. Present them the work of numerical algorithms on concrete examples on the computer.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.define and calculate errors in numerical problems and conclude the reasons for error occurrence 2.based on a data analysis, create a function using approximation and interpolation 3.describe and solve a nonlinear equation and sets of linear and nonlinear equations with numerical methods 4.create a numerical integration problem model using practical examples 5.create a model for practical numerical problems 6.build a model for the finite difference method and finite elements method	
1.4. Course content	
Errors. Types of errors. Significant digits of an approximate number. Function error. Inverse problem. Interpolation. Interpolation problem. Lagrange, Newton and spline interpolation. Solving set of linear equations. Vector and matrix norm. Conditionality. Solving triangular systems. Direct methods (Gauss elimination methods without pivoting, partial pivoting and complete pivoting), LU decomposition, Cholesky decomposition, QR decomposition and iterative methods (Jacobi, Gauss-Siedel). Solving nonlinear equations (bisection method, simple iteration, Newton method and Newton modification). Solving a set of nonlinear equations (Newton method, quasi-Newton methods). Approximation of functions. The least squares problem. Numerical integration (Trapezoidal rule, Newton-Cotes rule, Simpson's rule). Solving ordinary differential equations – initial value problems and boundary value problems (Euler's methods, Runge-Kutta methods, the finite difference method, finite element method and shooting method).	
1.5. Teaching methods	Lecture Auditory exercises
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. Course assessment	

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises	2	1,2,3,4,5,6	Lectures, Auditory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	1.2	1,2,5,6	Midterm exam	Evaluation of (written) exercises	20	40
Oral exam	1.5	1,2,6	Oral exam	Assessment of student's answers	25	50
Seminar paper	0.3	1,3,4,6	Oral presentation	Discussion upon presentation	0	10

1.10. Obligatory literature

1. Scitovski, R. Numerička matematika. Osijek: Sveučilište J.J.Strossmayera u Osijeku, Odjel za matematiku, 2015.
2. Chapra, S.C; Canale, R.P. Numerical methods for engineers. New York: McGraw-Hill Education, 2015.

1.11. Recommended additional literature

1. G.Dalquist, A.Björck, NumerischeMethoden, R.OldenbourgVerlag, München, 1972.
2. D.Kincaid, W.Cheney, NumericalAnalysis, Brooks/Cole PublishingCompany, New York, 1996.
3. J.Stoer, R.Bulirsch, Introduction to NumericalAnalysis, 2ndEd.,SpringerVerlag, New York, 1993.
4. W.H.Press, B.P.Flannery, S.A.Teukolsky, W.T.Vetterling, NumericalRecipes, CambridgeUniversityPress, Cambridge, 1989.
5. e-skripta: Zlatko Drmač, Vjeran Hari, Miljenko Marušić, Mladen Rogina, Sanja Singer, Saša Singer, Numerička matematika, Zagreb, 2008. Dostupno na: http://web.math.pmf.unizg.hr/~singer/num_mat/NM_0910/num_mat1.pdf

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv.prof.dr.sc. HEDERIĆ ŽELJKO, Izv.prof.dr.sc. BARIĆ TOMISLAV	
Course name	DE4I-04 Numerical Methods in Electromagnetism	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (elective) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (elective) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students to mathematical models of electrical and magnetic fields for numerical integration and differentiation, and introduce them to the basics of numerical methods in electromagnetism. Train students to perform electromagnetic field calculations using modern software tools for numerical calculations.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.use of basic physical laws and mathematical models of electrical and magnetic fields to solve numerical integration and differentiation 2.understand and apply iterative methods in solving the equation system 3.critically analyse results of simulations obtained by the finite difference method 4.critically analyse the results of simulations obtained by the finite element method 5.critically analyse the results of simulations obtained by the method of moments 6.create models in commercial FEM and BEM programmes for conducting engineering analyses and synthesis tasks	
1.4. Course content	
Principles and applications of numerical methods for solving practical electromagnetic problems (computer electromagnetism). Method of moments applied to electrostatics (charge distributions), distributions of leakage current on grounding conductors, antennas (radiation diagrams and antenna current distribution), and waves on transmission line. Finite difference method: heat transfer. Finite element method: heat transfer, magneto statics. Hybrid methods. Application of traditional analytical methods in electromagnetism: solution of solvable integral-differential equations with the application of capacity and inductance, charge and current distribution, etc. Computer programming: designing algorithms for applying the method of moments, finite differences and finite elements for the above examples in practice.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	2	1,2,3,4,5,6	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	0.5	2,3,4,5	Midterm exam	Evaluation of (written) exercises	25	50
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	2,3,4,5,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	10
Oral exam	1	2,3,4,5	Oral exam	Assessment of student's answers	20	40

1.10. Obligatory literature

1. Z. Haznadar, Elektromagnetska teorija i polja, Liber, Zagreb, 1972.
2. S. Berberović, Teorijska elektrotehnika–odabrani primjeri, Graphis, Zagreb,1998.
3. Sadiku, Matthew N.O. Numerical Techniques in Electromagnetics. CRC Press, 2000.
4. Haznadar, I; Štih, Z. Elektromagnetizam I i II. Zagreb: Školska knjiga, 1997.

1.11. Recommended additional literature

1. W.H.A. Schilders, E.J.W. ter Maten, Numerical Methods in Electromagnetics, Vol. 13: Special Volume, ELSEVIER, North Holland, 2005,
2. Z. Haznadar, Ž. Štih, Electromagnetics Fields, Waves and Numerical Methods, IOS Press, Ohmsha, Amsterdam, Vol. 20, 2000.
3. Matthew N.O. Sadiku, Numerical Techniques in Electromagnetics, CRC Press; 2 edition, 2000

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. NYARKO EMMANUEL-KARLO, Doc.dr.sc. FILKO DAMIR	
Course name	DAKb2-04 Object Based Programming	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(0+30+0)+0

1. Course description	
1.1. Goals	
Introduce the basic principles of object-oriented programming to students, introduce students to C # and Python programming languages, show how to design an application with a graphical user interface.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.identify the organisational structure and develop elements for the object model 2.create user-defined data types (classes) and suitable objects 3.develop a programme in an appropriate programming language which, based on object-oriented approach, solves a given problem 4.identify errors in a programme code and correct them, create an executable version of a programme and test it 5.design and create a computer programme that solves a given problem	
1.4. Course content	
Fundamental principles of object-oriented programming, differences compared to procedural programming. Program languages C# and Python. Concept classes and objects. Variables and methods as part of an object. Class properties and their access. Basic procedures for creating and destroying an object. Object lifetime. Polymorphism, list of diverse objects and virtual functions. Inheritance. Accessing class properties: private, protected and public. Operator overloading. Function and class templates. Exception handling. Templates. Threading and multi-threaded applications. Events. Creating applications with a graphical user interface.	
1.5. Teaching methods	Lecture Laboratory exercises
1.6. Comments	Classes can be taught in a foreign language (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. Course assessment	
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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises	2	1,2,3,4,5	Lectures, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	7	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	1,2,3,4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	10	30
Oral exam	1	1,2,3,4,5	Oral exam	Assessment of student's answers	18	35
Project tasks	1	1,2,3,4,5	Solving project tasks	Evaluation of a project assignment, presentation grading	0	25

1.10. Obligatory literature

1. Lutz, M. Learning Python, 5th Edition. O'Reilly Media, 2013.

1.11. Recommended additional literature

1. The Python Tutorial (https://docs.python.org/2/tutorial/)
2. C# Tutorial (http://www.csharp-station.com/tutorial.aspx)
3. L. Jesse: Programming C#, 4th Edition, O'Reilly Media, 2005 prijevod: Programiranje C#; Antić, Ana; Grgić, Marko

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. ŠLJIVAC DAMIR	
Course name	DEb2-05 Renewable Electricity Sources	
Study program	Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	6
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students to technologies used for power generation and cogeneration from renewable energy sources, as well as their technical, economic and environmental properties.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.identify current European directives and regulations concerning the promotion of renewable energy sources 2.specify all important technical and technological terms regarding RES power and cogeneration plants 3.evaluate real RES plants through practical experiences 4.estimate cost-benefit of construction of RES power and cogeneration plants 5.evaluate the basic characteristics of RES power and cogeneration plants 6.independently measure and analyse electrical quantities in RES power plants	
1.4. Course content	
Current European directives and regulations for enhancing renewable energy sources in producing electrical energy and cogeneration. Basic principles and the current status of power plants and cogeneration renewable energy sources power plants. Biomass and biogas cogeneration power plants. Wind power plants. Concentrated solar thermal power plants. Photovoltaic systems. Geothermal power plants. Small hydro power plants. Electrical schemes and influence of certain technologies to a power engineering system. Cost-effectiveness of electrical energy from power plants and cogeneration renewable energy sources power plants.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment	
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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1	1,2,3,4,5,6	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Practice – problem solving	2	5	Midterm exam	Evaluation of (written) exercises	10	20
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	20
Oral exam	2	1,2,3,4	Oral exam	Assessment of student's answers	25	50

1.10. Obligatory literature

1. Masters, G.M. Renewable and Efficient Electric Power Systems. Wiley 2nd edition 2013.

1.11. Recommended additional literature

1. L. Jozsa, D. Šljivac, D. Topić, Proizvodnja električne energije iz neobnovljivih i obnovljivih izvora energije, udžbenik, ETF Osijek (u izradi, očekivana godina izdavanja: 2016.)
2. D. Šljivac, Z.Šimić, Obnovljivi izvori energije s osvrtom na gospodarenje, HKAIG, 2008.
3. Thomas Ackermann, Wind Power in Power System, Wiley, 2007.
4. G.M. Masters, Renewable and Efficient Electric Power Systems, Wiley 2nd edition 2013.
5. Kaltschmitt, Martin, Streicher, Wolfgang, Wiese, Andreas (Eds)., Renewable Energy Technology, Economics and Environment, Springer, 2007
6. D.Pelin, D.Šljivac, D.Topić, V.Varju, Utjecaj fotonaponskih sustava na regiju,, ETF Osijek, MTA RKK Pecs, 2014.
7. REN21 Renewable Global Status Report (2014.). http://www.ren21.net
8. IEA Renewables: http://www.iea.org/topics/renewables/
9. EC JRC Strategic Energy Technologies Information System (SETIS) reports: https://setis.ec.europa.eu/publications/jrc-setis-reports
10. Važeće europske direktive i zakonska regulativa za poticanje OIE u RH

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv. prof.dr.sc. RUPČIĆ SLAVKO	
Course name	DKa2-05 Optoelectronic Communications	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description	
1.1. Goals	
Familiarise students with the basic principles of propagation of light in guided and unwanted media. Present basic subsystems of optoelectronic communication systems, ways of modulating and multiplexing optical signals and architecture of optoelectronic networks.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.define the most important terms that appear in the field of optoelectronic communications 2.describe and explain the propagation of light by a single mode and multiple optical fibres using the fundamental propagation light laws 3.evaluate the operating principles of basic subsystems of optoelectronic receivers and transmitters based on coherent and non-coherent detection 4.analyse and evaluate the operating principles of optoelectronic receivers and transmitters system based on coherent and non-coherent detection 5.describe and explain the features and methods of modulating and multiplexing optical signals (WDM, FDM, SCM, OTDM) 6.present the mode and architecture of optical networking technologies, LAN and WAN network structures and SONET / SDH optical networks	
1.4. Course content	
Theory of optical communications. Light propagation in fibres and power loss. Fibre and fibre nonlinearities. EM modes, modes coupling. Optical detection theory. Optical sources and transmitters. Optical detectors and receivers. Optical amplifiers. Modulations. Direct detection optical systems. Coherent systems. Multi-channel optical systems (WDM, FDM, SCM, OTDM). Fibre optic communications networks. Optical communication in atmosphere, antennas.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
1.6. Comments	Classes can be taught in a foreign language (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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1.2	1,2,3,4,5,6	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	2	5
Practice – problem solving	2.3	2,3,4,5	Midterm exam	Evaluation of (written) exercises	15	30
Writing pre-lab write-ups, results analysis and writing laboratory reports	0.5	1,2,3,4	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	20	30
Oral exam	1	1,2,3,4,5	Oral exam	Assessment of student's answers	18	35

1.10. Obligatory literature

1. Blair, S. ECE 5411- Optical Communication Systems.USA: Utah. Edu.,notes, 2008.

1.11. Recommended additional literature

1. R.Ramaswami, Optical Networks, Morgan Kaufman Publishe, INc., 1998.
2. Yariv, Optical Electronics in Modern Communications, Oxford University Press, Eng.,1996.
3. R Pramod, Optical measurememt Techniques and Applications Norwood ArtechH ouse, 1997.
4. M.Cvijetić, Digitalne svjetlovodne komuninkacije, Naučna knjiga, Beograd, 1989.
5. G.P.Agrawal, Fiber-Optic communication Systems, John Wiley & Sons, N.Y.,1997.
6. G. Keiser, Optical Communications Essentials, Mc_Graw Hill,N.Y. 2003.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. FEKETE KREŠIMIR, Doc.dr.sc. KNEŽEVIĆ GORAN	
Course name	DE4I-05 Power System Planning	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (elective) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (elective) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(0+15+15)+0

1. Course description	
1.1. Goals	
The aim of the course is to enable students to independently define and solve optimization problems of short-term planning of power system operation in the electricity market environment.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.categorise the basic concepts of short-term planning of a power system 2.describe the following optimization problems: Economic dispatch, Optimal power flow, Thermal unit commitment, State estimation and Hydro unit commitment 3.compare the economical load distribution and optimal power flows for a default model of a power system in the computer programme 4.apply thermal and hydro unit commitment to the power system using computer program 5.create the objective function and the associated constraints for the optimisation problem for a hybrid power system	
1.4. Course content	
Introduction - structure of a power system, basic concepts of short-term planning in a power system, electricity market overview, electricity demand forecasting. Optimisation functions used in energy management systems: economic dispatch, optimal power flow, thermal unit commitment, state estimation and hydro unit commitment.	
1.5. Teaching methods	Lecture Laboratory exercises Construction exercises
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. Course assessment	

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises, Design exercises	1.5	1,2,3,4,5	Lectures, Laboratory exercises, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	3,4	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	10	20
Oral exam	1.5	1,2	Oral exam	Assessment of student's answers	25	50
Problem-solving related to design exercises	1	4,5	Design exercises	Evaluation of problem solving exercises	15	30

1.10. Obligatory literature

1. A.J. Momoh, Electric Power System Applications of Optimization, CRC Press, Taylor & Francis Group, Boca Raton, Florida, 2009.
2. Lukač Z; Neralić L. Operacijska istraživanja. Zagreb: Element , 2012.

1.11. Recommended additional literature

1. A.J. Wood, B.F. Wollenberg, Power Generation Operation and Control, John Wiley & Sons, Inc., New York, 1996
2. M. Shahidehpour, H. Yaminand Z. Li, Market Operationsin Electric Power System – Forecasting, Scheduling and Risk Management, John Wiley & Sons, Inc., New York, 2002
3. D.S. Kirschen, G. Strbac, Fundamentals of Power System Economics, John Wiley & Sons, Inc., New York, 2004.
4. S. Nikolovski, K. Fekete, G. Knežević, Z. Stanić, Uvod u tržište električne energije, Elektrotehnički fakultet Sveučilišta Josipa Jurja Strossmayera u Osijeku, 2010.
5. L. Söder, M. Amelin, Efficient Operation and Planning of Power System, 8th ed., Stockholm: Royal Institute of Technology, 2007.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	MAJDANDŽIĆ LJUBOMIR	
Course name	DE4I-07 Energy Storage and Reversibility	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (elective) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (elective) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students to the importance of energy storage and energy conversion as well as contemporary methods of energy reversibility.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.explain the principle of storage and reversibility of energy 2.analyze modes of storage and reversibility of energy 3.calculate the energy ratio of the device for electrolysis and energy from fuel cells 4.calculate the storage and reversibility of energy in an electric vehicle	
1.4. Course content	
Energy storage model. Reversibility principle. System entropy. Anergy and exergy of a system. Law of conservation of energy. Storing energy as kinetic energy. Storing energy as potential and reversible energy. Electricity storage. Energy storage in a capacitor. Supercapacitors. Water electrolysis devices. Storing energy as thermal energy. Hydrogen and fuel cells. Electric vehicles.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment	
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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1	1,2,3,4	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Practice – problem solving	0.5	4	Midterm exam	Evaluation of (written) exercises	8	15
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	2,3	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	20
Oral exam	2	1,2,3,4	Oral exam	Assessment of student's answers	20	40
Seminar paper	0.5	4	Individual meetings with students	Grading a seminar paper	8	15

1.10. Obligatory literature

1. Bošnjaković, F.: Nauka o toplini, Svezak prvi, drugi i treći, Graphis, Zagreb, 2012.

1.11. Recommended additional literature

1. Incropera, F.P., DeWitt, D.P.: Fundamentals of Heat and Mass Transfer, John Wiley,New York, 1996.
2. Winter, C-J, Nitsch, J.: Wasserstoff als Energieträger, Technik, Systeme und Wirtschaft, Springer-Verlag Berlin, Heidelberg, 1986.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv. prof. dr. sc. HERCEG MARIJAN	
Course name	DKa2-02 Transmitters	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students to the theoretical basics of oscillators, high-frequency tuned amplifiers, modulators, impedance matching circuits, and enable students to design basic VF circuits.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.design oscillators with negative resistance and positive feedback and understand their basic working principles 2.analyse the electrical conditions in LC and RC oscillator circuits 3.understand the structure and working principles of VF power amplifiers 4.design and analyse circuitry for impedance matching 5.understand the basic principles of the modulation procedures based on a sine and pulse signal carrier and evaluate their performances 6.recognise the structure and principle of pulse-coding and delta modulation and implement them	
1.4. Course content	
Oscillators. Theory of negative resistance oscillators and positive feedback oscillators. High-frequency LC oscillators. Low-frequency RC oscillators. Procedures for enhancement of oscillator amplitude and frequency stability. Oscillators with quartz crystal. Frequency synthesis procedures: direct and indirect synthesis, phase loop synchronisation. High-frequency power amplifiers (class A, B and C). Frequency multipliers. Sine-wave signal modulation: amplitude modulation (AM) and argument modulation (FM and PM), modulator and demodulator structures. Discrete modulation of sine-wave: amplitude shift keying (ASK), phase shift keying (PSK) and frequency shift keying (FSK), modulator and demodulator structures. Pulse modulation: pulse amplitude modulation (PAM), pulse width modulation (PDM), pulse position modulation (PPM) and pulse frequency modulation (PFM), modulator and demodulator structures. Digital modulation procedures: pulse-code modulation (PCM) and delta sigma modulation (DSM), modulator and demodulator structures.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	0.7	1,2,3,4,5,6	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	2.3	2,4	Midterm exam	Evaluation of (written) exercises	20	40
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	2,5,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	10	20
Oral exam	3	1,2,3,4,5,6	Oral exam	Assessment of student's answers	20	40

1.10. Obligatory literature

1. Grebennikov, Andrei. RF and Microwave Transmitter Design. John Wiley & Sons, Inc., 2011.
2. B.Modlic, I.Modlic, Pojačala snage: serija visokofrekvencijska elektronika, Školska knjiga, Zagreb, 1992.
3. B.Modlic, I.Modlic, Titranje i oscilatori, Školska knjiga, Zagreb, 1993

1.11. Recommended additional literature

1. I.Modlic, B.Modlic, Visokofrekvencijska elektronika - Oscilatori, pojačala snage, Školska knjiga, Zagreb, 1982.
2. B.Modlic, I.Modlic, Modulacije i modulatori : serija visokofrekvencijska elektronika, Školska knjiga, Zagreb, 1995.
3. B.Modlic, J. Bartolić, Miješanje, mješala i sintetizatori frekvencije, Školska knjiga, Zagreb, 1995.
4. G. Gonzalez, Foundations of oscillator circuit design, Artech House, 31. pro 2006.
5. Andrei Grebennikov, RF and Microwave Transmitter Design, a John Wiley & Sons, Inc., 2011.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv. prof.dr.sc. RUPČIĆ SLAVKO	
Course name	DKa3-02 Receivers	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory)	
Course status	Mandatory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students to basic parameters of analogue, digital and optical receivers. Explain the basic procedures for analysing the operation of these receivers as well as measurement procedures performed on receivers.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.define the fundamental concepts that appear in the area of receiving systems and receivers 2.analyse and evaluate the working principles of the basic subsystems of analogue heterodynamic, homodynamic and digital receivers 3.analyse and evaluate the working principles of analogue heterodynamic and homodynamic systems 4.analyse and evaluate the working principles of digital receivers 5.evaluate the concepts of analogue and digital receivers usng their main advantages and disadvantages 6.describe and explain the work of optoelectronic receivers based on coherent and incoherent detection	
1.4. Course content	
Characteristics of radio receivers: input characteristic, amplification, sensitivity, noise factor, selectivity, dynamic range, unwanted surges, stability and frequency accuracy, output characteristics. Analogue heterogeneous AM and FM transceivers (mono, stereo): VF amplifiers, oscillators, mixers, MF amplifiers, demodulators. Digital receivers, structures and subsystems. Broadcasting of digital data into FM audio broadcasting: RDS system, ARI system and AM broadcasting: DRM. FDM, TDM and CDM systems. Expanded spectrum systems and dedicated frequency modulation systems. Receivers in optoelectronic communications. Noise and interference in analogue and digital transmission systems.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment	
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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	2	1,2,3,5,6	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	2	5
Practice – problem solving	1	2,3,4	Midterm exam	Evaluation of (written) exercises	15	30
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	1,2,3,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	10	25
Oral exam	1	2,3,4,5,6	Oral exam	Assessment of student's answers	20	40

1.10. Obligatory literature

1. Rouphael, T.J. Wireless Receivers Architectures and Design. Elsevier Inc., 2015.
2. M.Gregurić, Radioprijemna tehnika, Ĺ kolska knjiga, Zagreb, 1994.
3. B.Modlic, Miješanje, mješala i sintezatori frekvencija, Ĺ kolska knjiga, Zagreb, 1995.

1.11. Recommended additional literature

1. M.Schwartz, Information transmission, modulatiom and noise, McGraw-Hill, New York, 1980.
2. I.Zahradka, radiokomunikacijski sustavi, Školska knjiga ,Zagreb, 1994.
3. B.Silvello, Coherent Optical Communication Systems, Eugenio Ianonne, 1994.
4. J.Budin, Optičke komunikacije, Univerza v Ljubljani, Ljubljana, 1993.
5. H.Meyr, Digital Communications Receivers, Wiley, 1997.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. NIKOLOVSKI SRETE, Izv. prof. dr. sc. MARIĆ PREDRAG	
Course name	DEab2-02 Transmission and Distribution of Electrical Energy	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Qualify students to independently analyse and compute voltage conditions, voltage drops, losses and short circuits in transmission and distribution networks. Selection and design of cable networks. Teach students about modern FACTS devices for voltage regulation and power flows in transmission networks and HVDC transmission with DC cables.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.understand modern Flexibile Alternating Current Transmission System for voltage and power flow regulation in a transmission network 2.analyse the working principles of HVDC transmission using cable and overhead lines as well as evaluate their basic schemes of connections and economic parameters 3.analyse the topology of distribution networks with all their advantages and disadvantages 4.evaluate different models of equivalent schemes from distribution network elements, transformers, loads, compensation battery, reactor, power flow and short circuit computations 5.create a model of distribution networks for short circuit computation in an isolated and grounded network 6.create and analyse the results of voltage drops and power losses in a distribution network using modern software 7.analyse and evaluate different types of voltage control in a distribution network	
1.4. Course content	
The basic configuration of AC transmission networks and schemes of HVDC power transmission systems and FACTS systems. Characteristics of HVDC transmission. SVC, STATCOM and other FACTS systems. Characteristics and basic parts of FACTS. Basic topology of distribution networks, advantages and disadvantages, protection and reliability of different topologies. Type of distribution transformer stations, single line diagrams, protection and techno-economical analysis. Type of distribution networks related to their grounding. Direct grounding using resistance, resonance inductor and insulated network. Equivalent scheme of a transformer, line, capacitor, inductor, load, and utility network. Computation of distribution networks. Planning of consumers loads. Rusck's formula. Short circuits in radial and meshed networks.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises

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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1.5	1,2,3,4,5,6,7	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Practice – problem solving	1.5	2,4,5,6	Midterm exam	Evaluation of (written) exercises	10	20
Writing pre-lab write-ups, results analysis and writing laboratory reports	2	5,6,7	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	20
Oral exam	2	1,2,3,4,5,6,7	Oral exam	Assessment of student's answers	25	50

1.10. Obligatory literature

1. Štefić, B; Nikolovski, S. Prijenos i distribucija el. energije. Skripta ETF Osijek 2008.
2. Sivanagaraju, S. Electric Power Transmission and Distribution. Pearson Education India, 2009.
3. S. Nikolovski, D. Šljivac â€śElektroenergetske mreže - Zbirka zadatakaâ€ť, ETF Osijek 2006

1.11. Recommended additional literature

1. Karlo i Marija Ožegović, Elektroenergetske mreže III ,IV, V, FSB Split Opal d.do.o 2002
2. S.N. Singh Electric Power generation, Transmission and Distribution, Prentice –Hall India 2003

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv.prof.dr.sc. HEDERIĆ ŽELJKO, Izv.prof.dr.sc. PELIN DENIS	
Course name	DAEbc2-04 Applied Power Electronics	
Study program	Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	45+(0+15+0)+0

1. Course description	
1.1. Goals	
Teach student's about the topology of power electronic converters (PECs) for connecting renewable energy sources to a power grid and/or loads as well as for vehicle drives. Present the modulation technique of switching with PEC components in terms of optimising the harmonic content of the loads current and/or voltage as well as the voltage harmonic content of a power grid or power supply system in typical applications. Introduce students to hybrid electric vehicles (HEVs). Teach students about the modelling technology for the purpose of carrying out the analysis and synthesis of work, power flows, integration and design of HEV drives. Teach students about modelling and analysing the operation of energy storage systems in electric vehicles.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.classify topologies of power electronic converters when connecting renewable energy systems with a grid and/or loads and for vehicle drives 2.classify modulation control techniques of power electronic converters (PEC) with respect to harmonic content of load current and load voltage 3.analyse the ways of connecting typical renewable energy sources with loads and/or sources 4.create HEV model simulation models, and perform critical analysis of simulation results 5.analyse energy storage systems in electric vehicles	
1.4. Course content	
Distribution of renewable energy sources and their special features when connecting to a power grid and/or loads. Topology of power electronic converters (PECs) for connecting wind turbines, photovoltaic modules (strings) and fuel cells to power grids and/or vehicles and vehicle systems. Modulation techniques for converter conversion PEC components in order to optimise the harmonic power content and/or load voltage as well as the harmonic content of the power supply or a power supply system in the vehicle. Hybrid power generation systems. Hybrid electric vehicles, drive modelling techniques for carrying out the analysis and synthesis of work, power flows, integration and design of drives. HEV subdivision and subsystems. Analysis of the operating mode of the vehicle with respect to a driving mode of the vehicle. Power flows and system losses. Define basic energy storage management systems - batteries, super capacitors and hybrid systems.	
1.5. Teaching methods	Lecture Laboratory exercises

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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises	1.4	1,2,4	Lectures, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	3	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	20	20
Oral exam	1.1	1,2,4	Oral exam	Assessment of student's answers	20	40
Writing a seminar paper and presentation of the best papers	1	3,5	Individuall work	Evaluation of the seminar paper a presentation of the paper	0	20
Team work	0.5	3,5	Team work	Team work evaluation. Evalution of students' answers.	0	10

1.10. Obligatory literature

1. B. Skalicki: Električni strojevi i pogoni , Zagreb FESB 2004
2. I. Flegar: Elektronički energetski pretvarači, Kigen, Zagreb, 2010.

1.11. Recommended additional literature

1. S. Sumathi,L. Ashok Kumar, P. Surekha: Solar PV and Wind Energy Conversion Systems, Springer, 2015.
2. R. Teodorescu, M. Liserre, P. Rodriguez: Grid converters for photovoltaic and wind power systems, John Willey & Sons Ltd, 2011.
3. A. Emadi: Handbook of Automotive Power Electronics and motor drives, Taylor & Francis Group, LLC, 2005.
4. M. Alaküla: Hybrid Drive Systems for Vehicles, Lund University
5. Tallner _Batteries or supercapacitors as energy storage in HEVs1. Lund University

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. BARUKČIĆ MARINKO	
Course name	DEc1-02 Application of Electromagnetic Theory in Power Engineering	
Study program	Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(0+30+0)+0

1. Course description	
1.1. Goals	
Introduce students to basic electromagnetic field laws. Train students for medium complex analyses of electrical and magnetic fields. Train students for basic analyses of electromagnetic waves in space and on transmission lines. Introduce students to the basics of numerical methods in electromagnetic field calculations. Train students for numerical calculations of an electromagnetic field by using simulation software.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.explain the basic physical laws and mathematical models of electrical and magnetic fields 2.choose the appropriate basic physical laws and mathematical models of electric and magnetic fields to solve middle complex problems in electrical and magnetic fields 3.use the physical laws of electromagnetic fields 4.validate the mathematical models of electromagnetic fields to solve middle complex problems 5.make a computer simulation model of middle complex problems in electrical and magnetic fields 6.validate the obtained results of simulated electromagnetic fields	
1.4. Course content	
The field theory in the fundamentals of electrical engineering. Basic laws of electrical and magnetic fields. Maxwell equations. Boundary conditions. Poynting vector and theorem. Vector and scalar electromagnetic potentials. Electrostatic field. Imaging method. Stationary current fields. Biot-Savart law. Self and mutual inductance. Introduction to electromagnetic wave theory. Plane wave: basic features, reflection and refraction, energy density, power flow, polarisation. Plane wave in dispersion medium, attenuated wave on lines. EM wave propagation in free space and on transmission lines. Introduction to field numerical calculations. Basics of the finite element method.	
1.5. Teaching methods	Lecture Laboratory exercises
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. Course assessment	

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises	2.5	1,2,3,5,6	Lectures, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	2	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	15	30
Oral exam	2.5	1,2,3,4	Oral exam	Assessment of student's answers	30	60
Solving problems by using computer simulations	1	4,5,6	Homework	Evaluating steps and exercise solution	5	10

1.10. Obligatory literature

1. Mehmedović, M; Štefanko, S. Teorija polja i valova. Osijek, ETF 2010.
2. Ulaby Fawwaz; Michielssen Eric; Ravaioli Umberto. Fundamentals of Applied Electromagnetics. Prentice Hall, 2010.
3. S. Berberović, Teorijska elektrotehnika - odabrani primjeri; Graphis, Zagreb, 1998.
4. http://maxima.sourceforge.net/documentation.html

1.11. Recommended additional literature

1. Z. Haznadar, Ž. Štih, Elektromagnetizam 1 i 2, Školska knjiga, Zagreb, 1997.
2. http://www.agros2d.org/down/
3. Knapp Vladimir; Colić Petar: Uvod u električna i magnetska svojstva materijala,Zagreb Školska knjiga 1990
4. http://www.femm.info/wiki/Documentation

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. VINKO DAVOR	
Course name	DKa3-03 Application of microcontroller systems	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory)	
Course status	Mandatory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	15+(0+30+15)+0

1. Course description	
1.1. Goals	
Introduce students to the architecture and operating principles of the microcontroller. Introduce practical skills with AVR microcontrollers. Explain the procedure for designing a microcontroller based system and how to consolidate the programming code and hardware into a functional unit.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.find and apply information from the datasheet of the microcontroller 2.interpret the C programming code written for a microcontroller 3.evaluate microcontroller performance 4.design a printed circuit board (PCB) 5.use the EAGLE software package and create a printed circuit board (PCB)	
1.4. Course content	
Basics of microcontroller systems, difference between microcomputers and microcontrollers, RISC architecture, popular solutions: AVR, PIC, Freescale. Programming languages and compilers: Arduino, C ++, BASCOM, ASSEMBLER, Atmel Studio. Design flow: coding, compiling, fuse and lock bits setup, programming hex files. Characteristics of the C programming language when applied to microcontrollers: pointer operations, bit-wise operations, variables. Communication with microcontroller systems: RS232, I2C, 1Wire. AVR microcontroller architecture, registers, input-output interfaces: current and voltage limits. Oscillators: internal RC, crystal. Analogue-digital conversion, timer circuits, comparator. Memory: Flash, EEPROM, SRAM. Work with interrupt routines, sleep modes, programming modes. Adding sensors and actors. Measurement of DC and AC values: voltage, current, power. Driving high power devices (pulse and width modulation, PWM), design of printed circuit boards, assembly, testing. Project implementation.	
1.5. Teaching methods	Lecture Laboratory exercises Construction exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises, Design exercises	1.3	1,2,4	Lectures, Laboratory exercises, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	5	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	0.8	1,2,3,4	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	18	21
Oral exam	0.8	1,2,3,4,5	Oral exam	Assessment of student's answers	20	39
Problem-solving related to design exercises	1.6	1,3,5	Design exercises	Evaluation of problem solving exercises	15	30

1.10. Obligatory literature

1. Muhammad Ali Mazidi; Sarmad Naimi, Sepehr Naimi, AVR Microcontroller and Embedded Systems: Using Assembly and C. Prentice Hall; prvo izdanje, 2010.

1.11. Recommended additional literature

1. Dhananjay V. Gadre and Nehil Malhotra, tinyAVR Microcontroller Projects for the Evil Genius, Mc.Graw-Hill, 2011.
2. John Catsoulis, Designing Embedded Hardware, O'Reilly 2005.
3. Atmel 8-bit AVR Microcontroller with 16K Bytes In-System Programmable Flash tehničke specifikacije, Atmel korporacija, 2010
4. Richard H. Barnett, Larry O'Cull, Sarah Cox, Embedded C Programming and the Atmel AVR, Delmar, SAD, 2003.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. BARUKČIĆ MARINKO, Izv. prof. dr. sc. NENADIĆ KREŠIMIR	
Course name	DI401-17 Service Learning Projects	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (elective) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (elective) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (elective) Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (elective) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	15+(0+15+30)+0

1. Course description
1.1. Goals
Using the Service Learning (SL) as an educational method, the possibilities of applying, transferring and enhancing acquired academic knowledge and skills from the STEM area, primarily from the field of electrical engineering, computer science and information technology, will be presented to students in order to solve real problems in the community. This will help students understand the relevance of their knowledge and give them the feeling of doing something good, positive and beneficial to the community. Students will be encouraged to work in teams and collaborate in designing, implementing and evaluating an SL project through which they will be able to offer some technical, IT solutions and additional education in the field of basic and applied engineering knowledge and skills to specific community target groups.
1.2. Conditions for enrollment
Requirements met for enrolling in the study programme
1.3. Learning outcomes
1.make a difference among service learning, volunteering, student practices and socially based research 2.critically evaluate the project as a structure of goals and activities and participate in team work on the project with the aim of developing technical and IT solutions that are subject to the programme of study 3.critically evaluate the methods and techniques of planning project activities and use the appropriate software tools behind design documentation (e-portfolio project) 4.manage the realisation of the project 5.create and present (in writing and orally) a project plan, final project report and documentation (e-portfolio)
1.4. Course content
The basic concepts of the Service Learning (SL) method, applicable technology for SL, examples of good practice from Croatia and abroad, methodology and design of the SL projects. Students will devise, prepare and work on projects during their laboratory exercises. Students will carry out projects through practical exercises. It is expected that other teachers will be involved

to design and mentor projects for SL in the course plan. Designing, preparing, implementing and evaluating SL projects related to the transfer of STEM competencies in the field of electrical engineering, energy, renewable energy, robotics, automation....

1.5. Teaching methods	Lecture Laboratory exercises Construction exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises, Design exercises	1.5	1,2,3,4,5	Lectures, Laboratory exercises, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	5	5
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	3,4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	15	30
Oral exam	1	1,2,3,4,5	Oral exam	Assessment of student's answers	15	30
Problem-solving related to design exercises	1	1,2,3,4,5	Design exercises	Evaluation of problem solving exercises	10	25
Keeping a work diary about project implementation in the community	0.5	4,5	Practical exercises	Evaluating a student project work diary	5	10

1.10. Obligatory literature

1. N. Mikelić Preradović, Učenjem do društva znanja: teorija i praksa društveno korisnog učenja, Zagreb: Zavod za informacijske studije (2009.)

1.11. Recommended additional literature

1. E. Tsang, Projects that Matter: Concepts and Models for Service-learning in Engineering, Staylus Publishing, 2000.
2. A. R. Bielefeldt, Service Learning in Engineering, Michigan Technological University, 2012.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv. prof. dr.sc. KLAIĆ ZVONIMIR	
Course name	DEbc2-03 Design of Electrical Installations, Lighting and Facilities	
Study program	Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description

1.1. Goals

Introduce students to the types of installations and types of protection in LV installations, as well as the concept of smart installations. Introduce students to light technology, light sources, interior and exterior lighting, lighting management systems, and lighting efficiency measures. Introduce students to requirements regarding the design of electrical installations and power facilities, types of lightning protection, protection measures in construction site installations and maintenance measures for power facilities.

1.2. Conditions for enrollment

Requirements met for enrolling in the study programme

1.3. Learning outcomes

1.interpret the low voltage grounding systems, type of protection against indirect and direct contact in low-voltage installations, parts and modes of smart installation and types of electrical schemes and diagrams
2.explain the basic photometric quantities, light sources with respect to technology, interior and exterior lighting features, control and monitoring systems and lighting efficiency measures
3.calculate voltage drops and select cross-section of connection lines. Calculate indirect contact protection and basic energy consumption for a lighting system
4.measure to determine the safety of low voltage installations and explain the most important requirements for the design of electrical installations and power plants in the Technical Regulation for low-voltage electrical installations and the Construction Act, duties and obligations of a designer, parts of technical documentation
5.define and classify the types of lightning protection, technical fire protection measures in electrical installations, protection measures in construction site installations and maintenance measures for power facilities
6.classify and categorise network traffic types, create and test lists for network traffic filtering, propose QoS settings

1.4. Course content

Basic terms and concepts (metrics, low voltage network designation, types of failures, networks, and installations). Valid electrical engineering regulations and standards. Lightning installation. Influence of electric current on a human body. Protection against indirect and direct contact voltage. Low voltage lines and networks. Voltage drop on line and choice of line due to a load. Types of consumables and consumer facilities. Overcurrent protection. Smart electrical installations. Basic luminous measurements, lighting classes, lighting quality criteria, and regulations. Indoor and outdoor lighting. Lighting control systems, lighting design. Efficiency of lighting. Legislation and documentation for a design and construction of electrical facilities, networks and

installations. Requirements of project documentation, types of electrical diagrams. Technical regulation for LV electrical installations, Construction law. Lightning and fire protection in electrical installations, protection measures in construction site installations and maintenance of power plant facilities.

1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1	1,2,3,4,5,6	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Practice – problem solving	1	4	Midterm exam	Evaluation of (written) exercises	10	20
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	4,6	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	20
Oral exam	2	1,2,5,6	Oral exam	Assessment of student's answers	25	50

1.10. Obligatory literature

1. Stojkov M; Šljivac, D; Topić, D ;Trupinić, K.; Alinjak, T; Arsoski, S; Klaić, Z; Kozak, D. Energetski učinkovita rasvjeta, Sveučilište J.J. Strossmayera, Elektrotehnički fakultet Osijek, 2016.
2. Boyce, P; Raynham, P. The SLL Lighting Handbook, The Society of Light and Lighting. February 2009 .

1.11. Recommended additional literature

1. Zakon o gradnji
2. Tehnički propis za niskonaponske električne instalacije
3. V. Srb, Kabelska tehnika, priručnik, Tehnička knjiga, Zagreb, 1970.
4. E. Širola, Cestovna rasvjeta, Grafika Hrašće, 1997.
5. N. Srb, Niskonaponske mreže i instalacije, Tehnička knjiga, Zagreb, 1991.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. BLAŽEVIĆ DAMIR, Doc.dr.sc. GRGIĆ KREŠIMIR	
Course name	DRa2K4I-05 Computer System Networks - Planning and Design	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (elective) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(0+30+0)+0

1. Course description	
1.1. Goals	
Provide students with practical knowledge in computer network design. Through lectures and exercises, train them for user requirement analysis, design, planning, configuration, implementation, analysis and debugging of a computer network. Introduce students to legal and technical regulations related to planning and construction. Special emphasis will be placed on project documentation, cost list, configuration files for network devices (computers for special purposes), their implementation and maintenance. Introduce students to practical approach in quality of service implementation in a specific network environment.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.recognise and describe problems in modern computer network management 2.demonstrate the development of LAN communication cables, make and verify the validity of a simple and extended LAN network by layers, use a network traffic analyser and elaborate on results 3.calculate and choose a scheme of IP addresses and masks for an arbitrary network 4.plan and design a local computer network, choose and explain the choice of passive and active network equipment 5.create a configuration file for a network device (switch and router) according to given conditions, implement it on a networking device and analyse the device operation 6.classify and categorise network traffic types, create and test lists for network traffic filtering, propose QoS settings	
1.4. Course content	
Introduction to legal and technical regulations related to computer network planning. Designing project documentation. Computer networks. Types and classification of computer networks. Passive and active network devices. Computer hardware and software. Composing configuration files for network nodes. Computer network planning, equipment specification, building and maintenance. Implementation of quality of service settings. Access lists creation.	
1.5. Teaching methods	Lecture Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises	1	1,4,6	Lectures, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	4	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	2,3,4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	8	15
Oral exam	1	1,4,6	Oral exam	Assessment of student's answers	18	35
Revision exams	1	2,3	Midterm exams (written exam)	Evaluation of exercises	8	20
Seminar paper	1	1	Pair work	Delivering and presentation of seminar papers	0	20

1.10. Obligatory literature

1. M. Radovan, Računalne mreže 1, Digital Point Tiskara, Rijeka 2010.
2. M. Radovan, Računalne mreže 2, Digital Point Tiskara, Rijeka 2011.

1.11. Recommended additional literature

1. L.L.Peterson, B.S. Davie, Computer Networks: A Systems Approach, Morgan Kaufmann, Burlington (Massachusetts), 2012.
2. H.Fred, Data Communications, Computer Networks and Open Systems, Addison-Wesley, London, 1996.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	lzv.prof.dr.sc. MATIĆ TOMISLAV (st.)	
Course name	DKa2-03 Radio-relay and Satellite Communications	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(30+0+0)+0

1. Course description
1.1. Goals
By successfully mastering the course, students will learn about radio relay systems and understand the way RR radio equipment works (MUX, modem, first transmitter). By preparing seminar papers, students will learn the methodology of designing an RR link and will handle topics from the field of mobile satellite systems, satellite antennas and the use of satellite communications for special purposes - TDRSS. Participants will acquire knowledge in the field of radio diffusion and communication satellites, and special purpose satellites: orbital positioning.
1.2. Conditions for enrollment
Requirements met for enrolling in the study programme
1.3. Learning outcomes
1.identify and understand the underlying concepts related to digital radio-relay (RR) and satellite (stationary and mobile) communication systems 2.describe and explain the key technical characteristics and parameters of radio equipment (low-noise input amplifier, MUX, output power amplifier, modem, transponder) and characteristics of typical RR and satellite antenna systems 3.evaluate the effects of propagation, atmospheric conditions and free space propagation losses on the quality of RR and satellite connection systems 4.evaluate and apply planning, reliability and quality of RR and satellite connections in terms of the frequency plan: channel arrangement, interference, parasitic cross-linking and intermodulation products 5.evaluate the methods and apply RR design planning procedures: estimation of connectivity of the first Fresnell's zone, calculation of propagation loss on the trail and fading and application of diversity techniques 6.evaluate and describe the difference between radio-diffusion, communication satellites and special purpose satellites with respect to the orbit position, satellite switching, influence of the atmosphere and the noise temperature of a receivere
1.4. Course content
Examples of radio-relay systems (analogue, digital, low-channel, multi-channel). Distribution of electromagnetic spectrum, planning of RR link. Reliability and quality of connection, reference circuit. Radio RR equipment connection: MUX, modem, first transmitter. Conditions of propagation: atmospheric effects, choking of free space. Antenna RR connection: antenna features, antenna types. Frequency plan: channel planning, interference, transverse-back connection to the back-to-back system, intermodulation products. RR Link Design: Fresnell's zone, budget route, failure, diversity technique. Synchronous digital hierarchy. Radio-diffusion and communication satellites, and special-purpose satellites: orbital accommodation. Technical characteristics and parameters of a communication satellite and terrestrial stations: antennas, low-noise pre-amplifiers, output amplifiers, transponders. Commutation on a satellite. Calculation of up-link and down-link. Influence of the atmosphere. Receiver

temperature of a receiver. Mobile satellite systems. Satellite antenna. Use of satellite communications for special purposes.

1.5. Teaching methods	Lecture Auditory exercises
1.6. Comments	Classes cannot be taught in the English language

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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	**ECTS**	**Learning outcomes**	**Teaching method**	**Assessment method**	**Points**	
					Min	**max**
Attendance Lectures, Auditory exercises	1	1,2,3,4,5,6	Lectures, Auditory exercises	Attendance register. Mandatory attendance percentage is: 70%.	5	10
Practice – problem solving	1.5	3,4,6	Midterm exam	Evaluation of (written) exercises	15	30
Oral exam	1.5	1,2,3,4,5,6	Oral exam	Assessment of student's answers	20	40
Seminar paper (S)	1	1,2,5,6	Seminar work (S)	Grading a seminar paper and presentation	10	20

1.10. Obligatory literature

1. Gerard., Maral; Bousquet; Michel ; Sun, Zhili . Satellite Communications Systems: Systems, Techniques and Technology. Wiley, 2009.
2. I.Modlic, B.Modlic, Visokofrekvencijska elektronika - Oscilatori, pojačala snage, Školska knjiga, Zagreb, 1982.
3. I.Modlic, B.Modlic, Visokofrekvencijska elektronika - Modulacija, modulatori, sintezatori frekvencije, Školska knjiga, Zagreb, 1982.

1.11. Recommended additional literature

1. M.Schwartz, Information, Transmission, Modulation and Noise, McGraw-Hill, 1980.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. BALEN JOSIP	
Course name	DRcKb2-05 Mobile platform application development	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(0+15+15)+0

1. Course description	
1.1. Goals	
Introduce students to technologies for developing mobile applications. Show how a user interface is developed, and explain application functionality and interface connectivity and functionality. Teach students how to test apps on devices and a simulator, and how to develop source code documentation.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.identify application-specific concepts for mobile applications 2.use a mobile application development platform 3.develop a complex mobile application and programme a user interface 4.implement structured and functional testing of applications on real-world mobile devices 5.create source code documentation of the application 6.recommend alternative approaches to solving a specific problem encountered during testing	
1.4. Course content	
Introduction to mobile application development tools. The main components of a mobile application. User interface design for mobile applications. Software solutions to real problems. The use of a program-specific concept to create mobile applications. Software design implementation. Software implementation of different functionalities. The use and management of sensors embedded in mobile devices. The use of a simulator to test application performance. Performing structural and functional testing on real-world mobile devices. Source code documentation generation	
1.5. Teaching methods	Lecture Laboratory exercises Construction exercises
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. Course assessment	
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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises, Design exercises	2	1,6	Lectures, Laboratory exercises, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	5
Writing pre-lab write-ups, results analysis and writing laboratory reports	0.4	2,3,4	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	15
Oral exam	0.3	1,3,6	Oral exam	Assessment of student's answers	20	40
Problem-solving related to design exercises	1	2,3,4,5	Design exercises	Evaluation of problem solving exercises	0	10
Designing a software solution	1.3	2,3,4,5	Independent work on a software solution	Testing and presentation of the created application	10	30

1.10. Obligatory literature

1. Razvoj mobilnih aplikacija-priručnik za edukaciju. Osijek: Elektrotehnički fakultet Osijek, 2013.
2. Phillips, Bill ; Stewart, Chris; Hardy, Brian; Marsicano, Kristin . Android Programming: The Big Nerd Ranch Guide (2nd Edition). Atlanta: Big Nerd Ranch, LLC., 2015,

1.11. Recommended additional literature

1. P. Sarang, Java Programming, Oracle Press, 2012.
2. I. F. Darwin, Android Cookbook Problems and Solutions for Android Developers, O'Reilly Media, 2012.
3. R. Cadenhead, Java 6 II izdanje, Kombib, 2008.
4. D. Poo, D. Kiong, S. Ashok, Object-Oriented Programming and Java, Springer Verlag, 2007.
5. Professional Android 4 Application Development, Reto Meier, Wiley, 2012.
6. M. Gargenta, Learning Android - Building Applications for the Android Market, O'Reilly Media, 2011.
7. Y. Fain, Programiranje Java, Wrox, 2011.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. GRGIĆ KREŠIMIR	
Course name	DKb2-03 Computer Systems Security	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	6
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description	
1.1. Goals	
Familiarise students with security issues in modern computer systems and networks (threats, attacks, risks), and provide knowledge required for planning, parameter design and implementation of modern cryptosystems, security mechanisms and security protocols into computer networks and systems.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.explain, categorise and describe different types of modern symmetric and asymmetric cryptosystems 2.interpret and describe the existing security threats, attacks and risks in modern computer and communication systems 3.explain properties, characteristics and implementation methods for different security systems and mechanisms intended for modern computer networks 4.estimate and evaluate different Internet security protocols and standards within computer systems and networks 5.analyse security requirements and implement security mechanisms in different types of wireless networks	
1.4. Course content	
Basic terms of cryptography. Substitution and transposition ciphers. Machines for encryption. Examples of symmetric cryptosystems and their application - DES, 3DES, IDEA, RC5, AES. Linear and differential cryptanalysis. Block cipher operating modes. Public key concept. Examples of asymmetric cryptosystems and their application - RSA, Diffie-Hellman, ElGamal, DSA. Cryptographic hash functions. Digital signature. Random number generators. Security policy and risk management. Security threats. Types of malware. Types of attack and possible countermeasures. Denial of service attack. Firewall types and configuration. Virtual private networks. Methods for intrusion detection and prevention. Intrusion detection systems - HIDS, NIDS. E-mail security. SSL and TLS. HTTPS. IPv4 and IPv6 protocol security – Ipsec. Authentication protocols. Secure routing. Security of wireless local area networks. WEP, WPA, WPA2. Security of ad hoc and sensor networks.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	2	1,2,3,4,5	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	1	4
Practice – problem solving	1.1	1,3,4,5	Midterm exam	Evaluation of (written) exercises	16	32
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	2,3,4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	12	24
Oral exam	1.5	1,2,3,5	Oral exam	Assessment of student's answers	15	30
Writing and presenting a seminar paper	0.4	3,4,5	Creation and presentation of seminar work	Grading a seminar paper and results presentation	6	10

1.10. Obligatory literature

1. Dujella, M. Maretić. Kriptografija. Zagreb: Element, 2007.
2. Stallings, M. Cryptography and Network Security - Principles and Practice (7th edition). Boston:Pearson, 2016.

1.11. Recommended additional literature

1. W. Stallings, Network Security Essentials – Applications and Standards, Prentice Hall, New Jersey, 2013.
2. W. Stallings, Computer Security – Principles and Practice, Prentice Hall, New Jersey, 2011.
3. A. Dujella, M. Maretić, Kriptografija, Element, Zagreb, 2007.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. BAUS ZORAN	
Course name	DEa2-04 Switching Devices and High-Voltage Engineering	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description	
1.1. Goals	
Explain to students how to determine the characteristics of a switchgear and their correct selection for a particular installation location in the power system, while satisfying the required power and voltage conditions. Students are able to define and recognise specific construction-related problems and the choice of high-voltage components.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.understand the types and uses of switchgears in power plants 2.apply the underlying concepts related to the electric field and penetrates in homogeneous and non-homogeneous electrical fields 3.summarise transient phenomena and interactions between a switchgear and power grid 4.evaluate the test results obtained by artificially produced high DC and alternating voltages in a high-voltage laboratory 5.using a computer, create a short-circuit current breaker to appropriately select the circuit breaker at the observed site in a power plant 6.create computer models for calculating electrodynamic and thermal stresses in switchgears	
1.4. Course content	
Electric field. Numerical calculations of electric fields. Dielectric gases. Gas spill. A homogeneous brew. Gas chopper in an inhomogeneous electrical field. Solid dielectric. Liquid dielectrics. Striking voltage. Surges. Principles of insulation coordination. Travel waves. Modelling elements for overvoltage calculation. High voltage, dielectric and digestion tests, high-voltage and AC voltage production in a high-voltage laboratory. Travel waves, overvoltages and overvoltage protection. Electrical contacts and energy theory of electrical arc. Contact resistance, tensile and layer resistance. Contact material properties and thermal contact stress. Types, characteristics and construction of a switchgear. Distribution and function of switchgears. Switches, switches, switches, resistor switches, disconnectors, disconnectors, grounders, fuses, surge arresters, spark plugs, control and auxiliary circuitry. Breaking power. Testing, maintenance, selection and design of switchgears.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1	1,2,3	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	1.5	5,6	Midterm exam	Evaluation of (written) exercises	20	40
Writing pre-lab write-ups, results analysis and writing laboratory reports	0.5	4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	5	10
Oral exam	2	1,2,3,5	Oral exam	Assessment of student's answers	25	50

1.10. Obligatory literature

1. Stojkov, M; Baus, Z; Barukčić, M; Provči, I. Električni sklopni aparati. Slavonski Brod / Osijek : Strojarski fakultet u Slavonskom Brodu, 2015.(udžbenik).
2. M. Barukčić, Z. Baus, Osnove električnih sklopnih aparata (zbirka zadataka s numeričkim rješenjima u MATHCAD-u), Elektrotehnički fakultet Osijek, 2010.
3. H. Požar, Visokonaponska rasklopna postrojenja, Tehnička knjiga - Zagreb, 1967.

1.11. Recommended additional literature

1. F. Greenwood, Electrical Transients in Power Systems, John Wiley & Sons, 1991.
2. B. Belin, Uvod u teoriju električnih sklopnih aparata, Školska knjiga-Zagreb, 1987
3. C.H. Flurscheim, Power Circuit Breakers - theory and design, Peter Peregrinus, Ltd., London 1975.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv. prof. dr. sc. MARIĆ PREDRAG	
Course name	DEa2-03 Power System Stability and Reliability	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory)	
Course status	Mandatory	
Year of study	1	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(15+15+0)+0

1. Course description	
1.1. Goals	
Explain to students the methods for analysis of power system stability and transient states with simulations of characteristic variables in the simulation tool.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.categorise power system stability 2.understand and to apply electromagnetic phenomena calculation methods in power system transient states 3.interpret voltage stability criteria, modal and participation analysis 4.calculate power system characteristic variables in transient states, sketch P-V, Q-V curves and eigenvalue plot 5.make an adequate system model and perform simulations of different transient states 6.interpret the influence of AVR, turbine, governor, invertors, compensators and renewable energy sources on power system stabilityquencies	
1.4. Course content	
Behaviour of transformers, inductors and electric rotating machines in power system transient states. Distributed parameter line model and wave propagation on multiphase systems. Transient and temporary overvoltage, dielectric strength under transient voltage, corona phenomena, characteristics of surge arresters. Synchronous machine – reactive power capability curve, single machine infinite bus system, synchronisation criterions, asynchronous operation characteristics, resynchronisation. Power system stability definition and classification. Transient stability, step by step-method, critical fault clearing angle and time, AVR impact, turbine and governor impact, different type compensators impact on transient stability. Oscillatory stability, modal analysis, modal participation factors. Voltage stability classification, dΔQ/dV criteria, dE/dV criteria, dQG/dQL criteria, Q-V and P-V curves, impact of AVR on voltage stability, voltage collapse. Stability of interconnection, multi-machine system incremental model, impact of renewable energy sources on power system stability.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	2	1,2	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	1.2	1,2,3,4	Midterm exam	Evaluation of (written) exercises	25	50
Writing pre-lab write-ups, results analysis and writing laboratory reports	0.2	1,2,3,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	5	10
Oral exam	1.6	1,2,3,5,6	Oral exam	Assessment of student's answers	20	40

1.10. Obligatory literature

1. Z. Haznadar, ž. Štih : Elektromagnetizam, Školska knjiga, Zagreb, 1997.
2. J.Machowski, J. W. Bialek, J. R. Bumby :POWER SYSTEM DYNAMICS Stability and Control -Second Edition; John Wiley & Sons Ltd, West Sussex, PO19 8SQ, United Kindom, 2012
3. Gibbard, M.J; Pourbeik, P; Vowles, D.J. Small-signal stability, control and dynamic performance of power systems. University of Adelaide Press, 2015.

1.11. Recommended additional literature

1. Paul M. Anderson, A. A. Fouad : Power System Control and Stability, The Institute of Electrical and Electronics Engineers, Inc. New York, 1994.
2. PowerFactory User's Manual and Tutorial, DIgSILENT PowerFactory Version 14.0,DIgSILENTGmbH, Gomaringen, 2008.
3. DIgSILENT PowerFactory Version 15, User Manual,DIgSILENTGmbH,Gomaringen, 2013.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. GLAVAŠ HRVOJE, Izv. prof.dr.sc. RUPČIĆ SLAVKO	
Course name	DEK3-04 Professional practice in electrical engineering	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory) Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	9
	Workload (L+(AE+LE+CE)+S)	0+(0+0+200)+0

1. Course description
1.1. Goals
Introduce students to the work environment in a company, organisational structure of a production system, managers and their responsibilities, production technology, as well as to the prescribed measures and workplace health and safety procedures that are related to the production technology of the company. Students get acquainted with engineering jobs and tasks, and can be actively involved in these jobs under supervision of the assigned mentor, while respecting safety measures, professional and technological rules, as well as other company rules. Upon completion of the practice, students prepare a report on the performed practice, which should be in line with the common technical communication form.
1.2. Conditions for enrollment
The necessary requirements to enrol in the second year of the studies.
1.3. Learning outcomes
1.evaluate the organisational structure of a production-business system as well as the tasks and role of a manager 2.evaluate engineering tasks as well as the necessary knowledge and skills related to manufacturing technology in a company 3.evaluate and control measures and procedures prescribed for insuring safety at work related to the manufacturing technology of a company 4.acquire knowledge of engineering communication and apply it 5.master the skills of professional written expression and documentation, important in engineering communication
1.4. Course content
Professional training is done by students for a period of 200 hours (13 working hours per week on average). Each student realises an internship in a company doing jobs in the field. A student, guided by a tutor, learns about the organisational structure of the production, business system with production technology and occupational safety and is involved in engineering work respecting the protection measures, professional and technological rules as well as other company rules. During practical training, a student keeps a work record. Professional training is organised by the Faculty of Electrical Engineering, Computer

Science and Information Technology Osijek in cooperation with engineers employed in companies whose activity is in the field of electrical engineering. These engineers are appointed by the Faculty and they jointly create and coordinate practical work of students in companies. Organisation of practical training is regulated by the Manual on practical training of students enrolled in the professional study programme at the Faculty of Electrical Engineering, Computer Science and Information Technology Osijek.

1.5. Teaching methods	Construction exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance , Design exercises	6.5	1,2,3,4	, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	32	40
Problem-solving related to design exercises	1.5	1,2,3,4	Design exercises	Evaluation of problem solving exercises	15	30
Writing a report on realized practice	1	5	Practical training	Evaluation by the subject bearer	15	30

1.10. Obligatory literature

1. Pravilnik o stručnoj praksi studenata Elektrotehničkog fakulteta Osijek
2. Propisi o zaštiti na radu u RH

1.11. Recommended additional literature

1. -

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Izv.prof.dr.sc. PELIN DENIS	
Course name	DE4I-08 Uninterruptible Power Supply Systems	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (elective) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (elective) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	45+(0+15+0)+0

1. Course description	
1.1. Goals	
Familiarise students with the area of emergency /standby power systems, which set up the base for understanding, testing and designing of systems.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the study programme	
1.3. Learning outcomes	
1.classify the type of emergency/standby power supply systems regarding the time of connection, autonomy and characteristics of connected loads 2.evaluate the choice of the uninterruptible power supply subsystems with power electronic converters (UPS) regarding technical demands 3.choose a topological stucture of UPS in terms of characteristics of connected loads 4.analyse subsystems of UPS regarding on type and mode of power electronic converter connection 5.testing and install one, chosen UPS	
1.4. Course content	
Basic concepts. Classification of emergency /standby power systems with regard to the type of loads, battery autonomy and switching time. Types of emergency /standby power supply systems. Batteries. Electric generating units. Photovoltaic panels. Fuel cells. Uninterruptible power supply system (UPS). Hybrid systems. Selecting power and topology of uninterruptible power supply systems. Relevant guidelines, norms and directives.	
1.5. Teaching methods	Lecture Laboratory exercises
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. Course assessment	

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises	1.5	1,2,3	Lectures, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	20
Oral exam	1.5	1,2,4	Oral exam	Assessment of student's answers	23	45
Seminar paper and presentation of student`s seminar work.	1	1,2,3	Individuall work	Evaluation of the seminar paper a presentation of the paper	0	25

1.10. Obligatory literature

1. Skok, S. Besprekidni izvori napajanja. Kigen, 2002.

1.11. Recommended additional literature

1. I. Flegar: Elektronički energetski pretvarači, Kigen, Zagreb, 2010.
2. A.Kusko: Emergency/standby power systems; McGraw Hii Book Comp.,New York, 1989.
3. D.C.Griffith : Uninterruptuble power supplies, Marcel Dekker Inc., New York/Basel,1989.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. TOPIĆ DANIJEL	
Course name	DE4I-10 Thermal Applications of Renewable Energy Sources	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (elective) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (elective) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(0+0+30)+0

1. Course description	
1.1. Goals	
Introduce students to technologies for heat generation from renewable energy sources, cogeneration and trigeneration systems.	
1.2. Conditions for enrollment	
The necessary requirements to enrol in the second year of the studies.	
1.3. Learning outcomes	
1.list types of renewable energy sources which can be used for heat generation 2.classify and list types of renewable energy sources which can be used for cogeneration and trigeneration 3.explain the application of certain types of renewable energy sources for thermal applications 4.calculate expected heat generation for different types of thermal applications of renewable energy sources	
1.4. Course content	
Classification of energy sources. Types of renewable energy sources. Biomass heating. Micro cogeneration and trigeneration systems in buildings. Geothermal energy. Heat pumps. Conversion of solar radiation into the heat for hot water and space heating. Solar cooling. Solar thermal power plants.	
1.5. Teaching methods	Lecture Construction exercises
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. Course assessment	
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 the students' work during the semester and on the final exam	

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Design exercises	2	1,2,3	Lectures, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	5	10
Oral exam	1	1,2,3,4	Oral exam	Assessment of student's answers	20	40
Problem-solving related to design exercises	1	1,2,3,4	Design exercises	Evaluation of problem solving exercises	15	30
Writing seminar paper	1	3,4	Seminar paper	Grading a seminar paper based on the preset criteria	0	20

1.10. Obligatory literature

1. Gerhard Stryi-Hipp: Renewable Heating and Cooling: Technologies and Application, Woodhead Publishing, 2015.

1.11. Recommended additional literature

1. Nicolae Badea: Design for Micro-Combined Cooling, Heating and Power Systems: Stirling Engines and Renewable Power Systems, Springer, 2015.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. MAJSTOROVIĆ VLADO	
Course name	D4-02 Project Management	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory) Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (mandatory) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (mandatory)	
Course status	Mandatory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(15+0+0)+0

1. Course description
1.1. Goals
Students will gain knowledge on formal definition of a project, ways of its initiation and progress, team work and formal tracking of project progress through processes and areas within the project management system. Students will become qualified for application of methodology in practice and design of project plans in the respective area. Furthermore, students will become acquainted with computer support for project design and management.
1.2. Conditions for enrollment
The necessary requirements to enrol in the second year of the studies.
1.3. Learning outcomes
1.define, distinguish between and link the basic concepts related to the field of organisation and project management 2.define and link strategy to project goals 3.identify and connect the basic processes and areas in project management 4.analyse, evaluate and propose appropriate tools and project planning techniques 5.propose a project planning methodology for a practical example and create a project plan 6.analyse and rank various project management software
1.4. Course content
Definition of project and project management. Project strategy and management. Project life – cycle, direct project participants and other stakeholders in the project. Appropriate project organisation. Basic processes of project management: initiation, planning, implementation, surveillance and control, inference. Techniques and tools for project management. Areas of project management: integrations project management, management of project volume, management of project time, expenses and quality, human resources management, project communication management, project risk management, project acquisition management. Techniques of project planning. Computer support of project management. Tools for project management support. Standard project documentation. Evaluation and documenting of experiences.

1.5. Teaching methods	Lecture Auditory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises	1.5	1,2,3,4,5,6	Lectures, Auditory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	1.3	4,5	Midterm exam	Evaluation of (written) exercises	25	50
Oral exam	1	1,2,3,4	Oral exam	Assessment of student's answers	15	30
Project task development	1.2	4,5,6	Self-development of a project assignment with mentorship of teachers	Evaluation of a project assignment	10	20

1.10. Obligatory literature

1. Majstorovic, V. Projektni menadžment. Sveučilište u Mostaru, 2010.
2. A Guide to the Project Management Body of Knowledge (PMBOK Guide), PMI, 2010.

1.11. Recommended additional literature

1. D. Satterson, J. Henessey, Computer Organization and Design: The Hardware/Software Interface (2nd Edition), Morgan Kaufmann Publ., San Francisco, 1997.
2. A. S. Tanenbaum, Structured Computer Organization, 7th ed., Prentice-Hall, New Jersey, 2005.
3. H. Kerzner, Project Management Case Studies, Willey, 2004.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. KNEŽEVIĆ GORAN	
Course name	DE4I-09 Grounding and earthing systems	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (elective) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (elective) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(0+15+15)+0

1. Course description	
1.1. Goals	
Explain to students the design of the grounding system of power plants. Train students to be able to independently calculate and measure ground resistance of power plants.	
1.2. Conditions for enrollment	
The necessary requirements to enrol in the second year of the studies.	
1.3. Learning outcomes	
1.define the basic concepts of grounding and earthing systems 2.evaluate the results of ground resistance calculation for rods, strip, foundation grounding and grounding grids 3.construct composed grounding by a combination of strips and rods 4.measure the resistance of grounding of electric power station 5.design a complex earthing system of power substations using computer software	
1.4. Course content	
Grounding types, definition of grounding and grounding systems. Soil characteristics, seasonal changes in ground resistance, soil resistance measurements. Touch voltage, step voltage, and electrical shock protection criteria. Theoretical settings for the calculation of ground resistance, basics of numerical methods for the analysis of the grounding system. Vertically placed grounding electrodes, potential distribution, and calculation of the ground resistance of rods. Horizontally placed grounding electrodes, potential distribution, and calculation of the ground resistance of the horizontal conductor. Grounding in concrete foundations, metal reinforced foundations as grounding systems. Combined grounding with group of rods and horizontal conductors, ray grounding, ring grounding, net grounding. Grounding for the protection against atmospheric discharge (impulse grounding). Reduction factor of grounding, application of metal sheathing cable as grounding, potential recovery problems. Special grounding electrodes. Grounding design of TS 10 (20) / 0.4 kV and poles of power lines 10 (20) kV. Calculation of ground resistance and potential distribution using the CYMGRD Programming Pack for different grounding configurations.	
1.5. Teaching methods	Lecture Laboratory exercises Construction exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises, Design exercises	1	1,2,3	Lectures, Laboratory exercises, Design exercises	Attendance register. Mandatory attendance percentage is: 70%.	3	5
Writing pre-lab write-ups, results analysis and writing laboratory reports	1.5	4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	8	15
Oral exam	1.5	1,2,3,5	Oral exam	Assessment of student's answers	25	50
Problem-solving related to design exercises	1	2,3,5	Design exercises	Evaluation of problem solving exercises	15	30

1.10. Obligatory literature

1. Majdandžić, F. Uzemljivači i sustavi uzemljenja. Zagreb: Graphis, 2004.
2. He Jinliang; Zeng Rong; Zhang Bo. Methodology and technology for power system grounding. IEEE, John Wiley & Sons Singapore, 2013.
3. H. Požar, Visokonaponska rasklopna postrojenja, Tehnička knjiga - Zagreb, 1967.

1.11. Recommended additional literature

1. A.P. Sakis Meliopulos, Power System Grounding and Transients: An Introduction, Marcel Dekker, Inc., New York, 1988.
2. M. Padelin, Zaštita od groma, Školska knjiga, Zagreb 1987.

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. GLAVAŠ HRVOJE	
Course name	DEab3-02 Power System Operation Control	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Introduce students with the basics of regulation in the power system, with the basics of power system management, as well as meet the needs of consumers for power and energy.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.analyze the regulation of the active power and power of the power plant while working on its own network 2.evaluate the regulation of active power and voltage of a power plant during parallel operation with the power system 3.create predispositions for regulating the power and frequency of the power system 4.evaluate higher-level cooperation between power systems 5.analyze coordinated voltage regulation in the power system 6.create a plan of energy and power requirements for the power system	
1.4. Course content	
Basic physical laws of the power system. Control of active power and power of the power plant working on its own network. The regulation of active and reactive power of the power plant in parallel operation with the system. Active power and frequency regulation of EES. High-level co-operation between power systems. Coordinated voltage regulation in the power system. Upravljanje_EES infection. Communication and network protocols. Collecting data from the real system. Application Programs. SCADA system. The functions and structure of remote control centers. Displacement Displacement Centers (NDCs). Structure and Tasks of Program Support in NDC (EMS). Programs for ON-LINE EE Network Analysis. Programs for OFF-LINE EE Network Analysis (Power Fuses, Power Plants, Network Displacement Drive Centers, DMS Functions, Industrial Remote Control Centers, Industrial Network Management Software, Intelligent Alarm Processing in EES, Satisfying Needs For energy and power in EES.	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	1.8	1,2,3,4,5,6	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	1.7	1,2,3,4,5,6	Midterm exam	Evaluation of (written) exercises	20	40
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	2,3,4	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	10
Oral exam	2.5	1,2,3,4,5,6	Oral exam	Assessment of student's answers	25	50

1.10. Obligatory literature

1. L. Jozsa: Vođenje pogona elektroenergetskog sustava, skripta, ETF Osijek, 2005

1.11. Recommended additional literature

1. P. S. R. Murty: Operation and Control in Power Systems, BS Publishers Hyderabad, 2008
2. M. Zima, M. Bočkarjova: Operation, Monitoring and Control Technology of Power Systems, ETH Zürich, 2007
3. I. Fagarasan, S. St. Iliescu, N. Arghira, Advances in Power System Control, Proceedings of the 1st Workshop on Energy, Transport and Environmental Control Applications, pp 62-71 ISBN 978-973-618-218-1, Targoviste, 2009
4. Modern Power System Control and Operation; A. S. DEBS; DSI; 1988; ISBN: ISBN-13 978-0898382655
5. T. Tomiša: Vođenje elektroenergetskog sustava, sažetak predavanja, FER Zagreb, 2007, http://www.fer.unizg.hr/_download/repository/PREDAVANJA%5B1%5D.pdf

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Prof.dr.sc. NIKOLOVSKI SRETE	
Course name	DE3-01 Power System Protection	
Study program	Graduate study programme, branch: Power Engineering, elective block Power Engineering systems (mandatory) Graduate study programme, branch: Power Engineering, elective block Industrial Power Engineering (mandatory) Graduate study programme, branch: Power Engineering, elective block Sustainable Power Engineering (mandatory)	
Course status	Mandatory	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	7
	Workload (L+(AE+LE+CE)+S)	45+(15+15+0)+0

1. Course description	
1.1. Goals	
Teach the students to chose,esign perform calculation for overcurrent m under/over voltage, over/under frequency , differential and distance protection of generetors, transformers, motors, electrical overgead and cable lines and electrical substations.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.understand all types of protection devices and their tasks in the power system 2.understand the basic principles of operation of electromechanical current, voltage and power relays 3.analyse and simulate by means of simulation software the performance of distance protection relays in high-voltage transmission lines 4.evaluate features of digital relay protection for generators, transformers and transmission lines 5.create models of overcurrent and directional current relays in distribution networks with distributed generation and evaluate the features of their performance 6.simulate calculations by using state-of-the-art tools for coordination of overcurrent protection	
1.4. Course content	
The basic task of protection, working priciple and properties of protectionin EPS. The basic demands of protection, speed, selectivity, sensitivity and redudancy of protection relays. The basic working principe of electromechanical and static current, differential, voltage and power relays. Overcurrent relay with definite and time depenedent characteristic. Voltage and frequency and power relays. Static relays with one and several electical values. Faults and unallowed conditions of generators. Protection of short circutis between stator windings. Protection of stator ground faults. Protection of short circuit beween windings of the same stator phase. Protection of ground fault in exiter winding. Overload protection. Protection of short circuit. Overvoltage protection. Reverse power protection (motor work). Protection of asynhronous work (loss of exitation). overspeed protection. Thermal protection. Critera of protection..	
1.5. Teaching methods	Lecture Auditory exercises Laboratory exercises

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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Auditory exercises, Laboratory exercises	2.5	1,2,3,4,5	Lectures, Auditory exercises, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	0	0
Practice – problem solving	1.5	3,4	Midterm exam	Evaluation of (written) exercises	25	50
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	3,4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	0	0
Oral exam	2	1,2	Oral exam	Assessment of student's answers	25	50

1.10. Obligatory literature

1. Nikolovski, Srete. Zaštita u EES-u. Osijek : ETF, 2007.
2. Singh, S.N. Electric Power generation, Transmission and Distribution. India, Prentice –Hall, 2003.

1.11. Recommended additional literature

1. Network protection and automation Guide, AREVA , priručnik 2011
2. S. Horowic,A. Padke Power system relaying RSP Ldt. 1995
3. P.M. Anderson Power systm protection IEEE Press series, New York, 1999
4. C. Russel Mason The Art &Science of protective relaying General electric.
5. ABB, SIEMENS Končar katalozi

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses as a whole).

General information		
Lecturer	Doc.dr.sc. KRPIĆ ZDRAVKO	
Course name	DKR4I-04 Green Computing	
Study program	Graduate study programme, branch: Communications and Informatics, elective block Communication Technology (elective) Graduate study programme, branch: Communications and Informatics, elective block Network Technology (elective)	
Course status	Elective	
Year of study	2	
ECTS credits and teaching methods	ECTS credits	5
	Workload (L+(AE+LE+CE)+S)	30+(0+30+0)+0

1. Course description	
1.1. Goals	
Enable students to become familiar with and include them in the processes of development, improvement and application of the environmentally friendly computing technologies. Demonstrate to students the scope and amount of impact of computer systems on the environment and present them ways to recognize the potential of green progress in computing technologies. Provide students with current knowledge of (energy) efficient hardware and software technologies.	
1.2. Conditions for enrollment	
Requirements met for enrolling in the second year of the study programme	
1.3. Learning outcomes	
1.identify and understand the environmental impact of the computing 2.evaluate energy acceptability of a computer system by using appropriate metrics and tools 3.design and independently create software solutions using frequency and voltage scaling and throttling of hardware processing capabilities 4.apply dynamic voltage and frequency scaling technology and hardware performance throttling in software development 5.assess potential omissions in energy efficiency of the existing computer systems	
1.4. Course content	
Introduction to the impact of computing on the environment. Evaluating energy efficiency of computer systems. Designing sustainable computer systems. Application layers of green technologies in computing. Basics of computer hardware. Green hardware technologies in computing. Frequency and voltage scaling of processing units. Throttling processing capabilities of computing hardware units. Other technologies for reducing the impact of computer hardware on the environment. Distributed and parallel computing. Programming technologies for reducing an energy footprint. Energy conscious models of software. Energy aware software paradigms. Implementation of energy saving technologies on a software level. Energy aware operating systems. Low-energy computer systems: SoC and MPSoC. Technology of installation and cooling of data and processing centres. Combining green technologies into ready-made solutions.	
1.5. Teaching methods	Lecture Laboratory exercises
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. Course assessment

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 the students' work during the semester and on the final exam

Student's activity	ECTS	Learning outcomes	Teaching method	Assessment method	Points	
					Min	max
Attendance Lectures, Laboratory exercises	1	1,2,3,4,5	Lectures, Laboratory exercises	Attendance register. Mandatory attendance percentage is: 70%.	8	10
Writing pre-lab write-ups, results analysis and writing laboratory reports	1	2,3,4,5	Laboratory practice	Assessment of pre-lab write-ups, supervision of laboratory exercises, evaluation of written reports	10	20
Oral exam	1	1,2,3,4,5,6	Oral exam	Assessment of student's answers	15	30
Research, analysis and report writing, team work	1	2,3,5,6	Presenting a seminar paper	Analysis of the seminal paper, assessing the amount of work as a team member	10	20
Solving tasks and answering questions	1	1,2,3,5,6	Midterm exams (written exam)	Analysis and checking of the assignment and answers to questions	10	20

1.10. Obligatory literature

1. Ahmad, Ishfaq ; Ranka, Sanjay. Handbook of Energy-Aware and Green Computing - Two Volume Set, Chapman & Hall/CRC Computer and Information Science Series, 2012., Florida, SAD

1.11. Recommended additional literature

1. Hu, Wen-Chen, ed. Sustainable ICTs and management systems for green computing. IGI Global, 2012.
2. Albert Y. Zomaya and Young Choon Lee. 2012. Energy Efficient Distributed Computing Systems (1st ed.). Wiley-IEEE Computer Society Pr.
3. Krpić, Zdravko; Horvat, Goran; Žagar, Drago; Martinović, Goran, Towards an energy efficient SoC computing cluster, Proceedings of 37th International Convention on Information and Communication Technology, Electronics and Microelectronics (2014), str. 178 – 182
4. Martinović, Goran; Krpić, Zdravko, Towards Green HPC Blueprints, Proceedings of the Second International Conference on Cloud Computing, GRIDs, and Virtualization, Rim: IARIA, 2011, str. 113 – 118
5. Gruber, Ralf, and Vincent Keller. HPC@green It: Green High Performance Computing Methods. Berlin: Springer-Verlag, 2010.
6. Urs Hoelzle and Luiz Andre Barroso, The Datacenter as a Computer: An Introduction to the Design of Warehouse-Scale Machines (1st ed.). Morgan and Claypool Publishers, 2009. (dostupno na http://www.cs.berkeley.edu/~rxin/db-papers/WarehouseScaleComputing.pdf)

1.12. Monitoring of students

Conducting university questionnaires on teachers (student-teacher relationship, transparency of assessment criteria, motivation for teaching, teaching clarity, etc.). Conducting Faculty surveys on courses (upon passing the exam, student self-assessment of the adopted learning outcomes and student workload in relation to the number of ECTS credits allocated to activities and courses

as a whole).