**J.J. Strossmayer University of Osijek**
**Faculty of Electrical Engineering**
**KnezaTrpimira 2b**
**31 000 OSIJEK**

# Application-oriented Study Programme in Electrical Engineering

Osijek, May 2008

# Contents

## 1. INTRODUCTION

### *a) Rationale for founding the Faculty*

Faculty of Electrical Engineering in Osijek was founded in 1978 with the application-oriented study programme in electrical engineering. During that period, the Faculty has developed into a respectable institution in material and staff terms, which is the basis for implementing study programmes at the highest level. During the previously mentioned period, the Faculty has been equipped with modern lecture rooms and staff offices, but what is more important it has equipped laboratories, which are of greatest importance in the modern college-level education of students of electrical engineering.

*Assessment of rationale regarding the requirements of labour market* - The labour market in Croatia shows that experts who complete their two-year application-oriented study programme of electrical engineering find an employment easily so that there are hardly any unemployed engineers of the mentioned profile. The two-year application-oriented study programme in electrical engineering educates engineers for the field of specialisation in Power Engineering, Computer Science and Automation, that can easily be integrated into the organisational structure of companies and institutions. The omnipresent interdisciplinarity determines the presence of electrical engineering and computer engineering in every segment of human life out of which follows the need for personnel of this profile. It is to be expected that this trend is going to be continued which is the main reason for starting a study of this profile. Engineers that will complete the two-year Application-oriented study programme in electrical engineering will obtain fundamental and specialised knowledge and skills to become part of the labour market. Worldwide experience shows that short–cycle engineers can easily find a job. Further social and economic development of modern society as well as Croatia in general is inconceivable without electrical engineering which is present in every segment of human life**.** Electrical engineering will undoubtedly remain the main initiator of the social development which will require highly educated experts that will be able to respond to the challenges of the new era. Highly educated experts of electrical engineering that are educated at the Faculty of Electrical Engineering in Osijek have found and will find their place at the labour market.

*Connection with modern scientific ideas and/or skills based on them*- The modern study of electrical engineering is based on the overall research and development in the field of natural and technical sciences but on new technologies as well. It is especially manifested in the development of electrical engineering and electronic industry which is supported by most recent ideas in the scientific field of electrical engineering. The initiator of the development and research in this field is the labour market, which supports further investment into science and research in the field of electrical engineering. Consequently, most recent scientific ideas have to be followed by research and development at the Faculty, in the first place within the framework of different projects supported by the Ministry of Science, Education and Sports, through projects supported by the European Union and certainly through cooperation and projects with economy.

*Comparability with programmes of other eminent foreign higher education institutions* – The Application-oriented study programme in electrical engineering at the Faculty of Electrical Engineering in Osijek is based on modern study programmes

of distinguished European universities and colleges. The programme is in term of contents completely comparable with the college level programme in electrical engineering at the Faculty of Electrical Engineering in Ljubljana and the college level of computer engineering and computer science at the Faculty of Electrical Engineering and Computer Science in Maribor. Comparison of the proposed Application-oriented study programme with branches in Automation, Power Engineering and Computer Engineering, with corresponding programmes at the faculties in Ljubljana and Maribor shows that there is a high level of programme coordination with the programmes considered.

*b) Experience in the implementation of equivalent or similar programmes*

Faculty of Electrical Engineering in Osijek has been educating engineers in the field of electrical engineering for many years. In 1978 the two–year college level study programme in electrical engineering was founded and since then the Faculty has been educating engineers of electrical engineering with the branches in Electrical Engineering and Electronics. In 1990, the application–oriented study programme develops into the Faculty of Electrical Engineering and as a consequence of that, new university programmes are introduced. According to the new curriculum of the two–year college level programme in electrical engineering, which was accepted in 2003, engineers of electrical engineering have been educated in the branches of Power Engineering**,** Automation and Computer Science. In this way an adjustment of the programme and contents of the two–year college level were made according to present and predictable market needs in the region of Eastern Croatia.

*c) Partners not in the higher education system, who are interested in starting the study of this profile*

Faculty of Electrical Engineering in Osijek has gained many partners in economy and public sector that are very interested in continuation and further development of their partnership with the Faculty. In the first place it is the partner company, Siemens that bases its branch–office on engineers in the field of electrical and computer engineering that are educated at the Faculty of Electrical Engineering in Osijek. Siemens plans further development and extension as well as employment of a considerable number of new personnel from the field of electrical and computer engineering. Other significant companies cooperating with the Faculty of Electrical Engineering are Croatian National Grid Company (Hrvatska elektroprivreda), Croatian telecommunications (THT), VIPNet as well as other companies interested in the study of such profile.

*d) Faculty overtness towards mobility of students*

Within the scope of the Application-oriented study programme in electrical engineering, students from other universities/faculties will be given an opportunity to take particular courses/modules or to study even whole semesters at the Faculty of Electrical Engineering in Osijek. Studying at other higher education institutions will be made available to our own students. Mobility of students as well as the teaching staff will be regulated on the basis of a partnership agreement between different universities/faculties. Coordination and agreeing of particular arrangements will be executed by ECTS coordinators of partnership institutions.

## 2. PRELIMINARIES

### 2.1. *Study programme*:

Application-oriented study programme

### 2.2. *Institution*:

J. J. Strossmayer University of Osijek, Faculty of Electrical Engineering Osijek in co-operation with other University institutions as well as business partners that would offer practical training to students.
Application-oriented study programme would be carried out at the Faculty of Electrical Engineering in Osijek, and its branches based in Vinkovci and Požega.

### 2.3. *Duration of study*:

Application-oriented study programme in electrical engineering would take **3 years** and a student should acquire a minimum of **180 ECTS credits**.

### 2.4. *Entry requirements*:

Application-oriented study programme would be open to applicants with secondary school education. On the basis of secondary school achievements a rank-list of applicants would be made, according to which admission to this study programme would take place.

### 2.5. *Qualification attributes or competencies electrical engineering students would achieve and positions they would be qualified for:*

Students who complete their Application-oriented study programme at the Faculty of Electrical Engineering in Osijek would acquire the necessary knowledge and skills to apply their knowledge of mathematics, physics, science and engineering to electrical engineering, as well as to conduct measurements, and analyse and interpret measurement results. Students of this profile would learn how to solve engineering problems. Furthermore, they would acquire abilities to recognise the interaction between engineering activities and design, manufacturing, user requirements and requirements of the manufacturing process. They should also learn how to adapt to technology changes and new techniques as part of a life long learning process. Moreover, electrical engineering students would display an understanding of engineering activities and their influence on life in general and the environment, demonstrating high moral and ethical principles while solving engineering tasks. Students would be able to apply the acquired knowledge to undertake appropriate further training aimed at improving their professional abilities.

**Branch: Power Engineering:**

Application-oriented engineers would acquire the necessary knowledge and abilities to construct, test and maintain the following:

- electrical installations at all levels of complexity (ranging from buildings, industrial plants to classical and nuclear power plants);
- transmission and distribution networks and lines, switching substations, city substations, distribution overhead and underground networks;
- facilities and plants (industry, transport, etc.) of flexible manufacturing systems controlled by automated electromotive devices, electrical machines, semiconducting power converters, etc. in companies of various branches.

**Branch: Automation**

Application-oriented engineers would acquire the necessary knowledge and abilities to:

- design, implement, test and maintain automated technological, power and transport plants and processes,
- design and apply hardware and software support for computer process control;
- implement methods of testing, documentation and evaluation of automation systems.

**Branch: Computer Engineering:**

Application-oriented engineers would acquire the necessary knowledge and abilities to:

- purchase, develop, and maintain computers and computer systems as well as software products;
- apply computers in process and manufacturing system control;
- design and exploit of computer networks;
- design, implement and maintain business and private networks and the corresponding computer systems;
- apply and maintain hardware and software of design systems in other branches and sectors.

Based upon the knowledge and abilities application-oriented students of electrical engineering would acquire during their studies, they would be qualified to enrol in the continuing specialised second cycle study programme in electrical engineering both in Croatia and abroad.

2.8. *Qualification awarded after the successful completion of the study programme:*

After the successful completion of the Application-oriented study programme in electrical engineering students would be awarded the title **Bachelor of Engineering in** their respective branches: **Power Engineering, Automation or Computer Engineering**.

## 3. Program Description

### 3.1. Application-oriented study programme in Electrical Engineering - obligatory and elective courses

Curriculum of the Application-oriented study programme (Bachelor level) in electrical engineering is described in detail in tables showing the order of enrolling and carrying out respective study courses. The tables provide course titles, weekly workload (contact hours pertaining to lectures + problem solving + laboratory practice + design/construction exercises). The courses are assumed to be conducted for the whole semester, i.e. fifteen weeks. The total weekly workload of students relative to lectures and practice is at most 25 hours excluding their duties referring to Physical Education and optional courses. All courses are one-semester courses. Students can take respective examinations after completing lectures and practice/exercises. The estimated students' workload per semester is expressed by ECTS (European Credit Transfer System) credits. ECTS credits are assigned according to the following principles and criteria:

- Credits are assigned by setting a norm in one semester to 30 ECTS credits ;
- Number of credits assigned to each course represents part of students' workload and engagement within that particular course with respect to the total semester workload (30 ECTS credits); number of credits per one course is rounded to half a credit (0.5);
- Students' workload includes the total time required for successful course completion (lectures, problem solving, laboratory practice, design/construction exercises, preparation for practice and exercises, writing reports, testing laboratory practice, seminar papers, time spent studying, i.e. independent learning, tests and examinations, etc.);
- Detailed credit value has been determined on the basis of lecturer's estimation regarding content complexity, as well as a questionnaire conducted among students concerning the existing courses at the faculty and the time required for their successful completion.

***Course notation***

For easy reference courses are denoted by codes in the following way:

Course code: **S Bx y z**

where: **S** – one-letter symbol for the Application-oriented study programme
**B** – one- or multi-letter symbol for the study programme or an elective course module
**R** – Computer engineering courses
**E** – Power engineering courses
**A** – Automation courses
**I** – Elective courses
**x** – semester
**y z** – two-digit symbol for the course number in the semester

***Workload notation***

**P** - lectures
**A** – problem solving
**L** – laboratory practice
**K** - design/construction exercises

**1st Year**

**Semester 1**

| Code | *Lecturer* | *Course* | *Weekly workload* | | | | | *Examination* | *ECTS credits* |
|---|---|---|---|---|---|---|---|---|---|
| | | | P | A | L | K | Σ | | |
| S101 | Radoslav Galić, PhD, Full Professor | Calculus I | 3 | 2 | 0 | 0 | 5 | 1 | 6 |
| S102 | Ninoslav Slavek, PhD, Assistant Professor | Fundamentals of Computer System Implementation | 2 | 0 | 2 | 0 | 4 | 1 | 5 |
| S103 | Željka Mioković, PhD, College Professor | Physics | 2 | 2 | 1 | 0 | 5 | 1 | 5.5 |
| S104 | Tomislav Mrčela, PhD, Associate Professor | Engineering Graphics | 1 | 0 | 0 | 2 | 3 | 1 | 4 |
| S105 | Branka Pavlović, MA, Senior Lecturer, Ivanka Ferčec, BA, Senior Lecturer | Foreign Language I | 1 | 1 | 0 | 0 | 2 | 1 | 2 |
| **Branch: Computer Engineering** | | | | | | | | | |
| SR101 | Božidar Ivšinović, PhD, Lecturer | Fundamentals of Electrical Engineering | 3 | 2 | 1 | 0 | 6 | 1 | 7.5 |
| | | **TOTAL:** | **12** | **7** | **4** | **2** | **25** | **6** | **30** |
| **Branch:Automation Branch: Power Engineering** | | | | | | | | | |
| SAE101 | Milica Pužar, MSc, Senior Lecturer | Fundamentals of Electrical Engineering I | 3 | 2 | 1 | 0 | 6 | 1 | 7.5 |
| | | **TOTAL:** | **12** | **7** | **4** | **2** | **25** | **6** | **30** |
| S106 | Željko Širić, Senior Lecturer | Physical Education I | 0 | 0 | 2 | 0 | 2 | | |

**Semester 2**

| Code | *Lecturer* | *Course* | *Weekly workload* | | | | | *Examination* | *ECTS credits* |
|---|---|---|---|---|---|---|---|---|---|
| | | | P | A | L | K | Σ | | |
| S201 | Radoslav Galić, PhD, Full Professor | Calculus II | 3 | 2 | 0 | 0 | 5 | 1 | 7 |
| S202 | Radoslav Galić, PhD, Full Professor, | Mathematical Statistics | 2 | 1 | 0 | 0 | 3 | 1 | 5 |
| S203 | Slavko Rupčić, MSc, Senior Lecturer | Fundamentals of Electronics | 3 | 1 | 2 | 0 | 6 | 1 | 7.5 |
| S204 | Branka Pavlović, MA, Senior Lecturer, Ivanka Ferčec, BA, Senior Lecturer | Foreign Language II | 1 | 1 | 0 | 0 | 2 | 1 | 3 |
| **Branch: Computer Engineering** | | | | | | | | | |
| SR201 | Davor Antonić, PhD, Associate Professor | Programming | 3 | 1 | 2 | 0 | 6 | 1 | 7.5 |
| | | **TOTAL:** | **13** | **6** | **6** | **0** | **25** | **5** | **30** |
| **Branch: Automation Branch: Power Engineering** | | | | | | | | | |
| SAE201 | Milica Pužar, MSc, Senior Lecturer | Fundamentals of Electrical Engineering II | 3 | 2 | 1 | 0 | 6 | 1 | 7.5 |
| | | **TOTAL:** | **13** | **7** | **5** | **0** | **25** | **5** | **30** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| S205 | Željko Širić, Senior Lecturer | Physical Education I | 0 | 0 | 2 | 0 | 2 | 0 | 0 |

**2nd Year**

**Semester 3**

| Code | *Lecturer* | *Course* | *Weekly workload* | | | | | *Examination* | *ECTS credits* |
|---|---|---|---|---|---|---|---|---|---|
| | | | P | A | L | K | Σ | | |
| **Branch: Automation** | | | | | | | | | |
| SAEIR301 | Damir Karavidović, BSc, Lecturer | Measurements in Electrical Engineering | 3 | 1 | 2 | 0 | 6 | 1 | 7.5 |
| SAR301 | Goran Martinović, PhD, Assitant Professor | Digital Electronics | 3 | 0 | 2 | 0 | 5 | 1 | 6 |
| SARIE301 | Željko Hocenski, PhD, Full Professor | Computer System Architecture | 3 | 1 | 1 | 0 | 5 | 1 | 6.5 |
| SAIER301 | Dražen Slišković, PhD, Assistant Professor; | Basics of Automatic Control | 2 | 1 | 1 | 0 | 4 | 1 | 5 |
| | | Elective course | | | | | 4 | 1 | 5 |
| | | **TOTAL:** | **11** | **3** | **6** | **0** | **24** | **5** | **30** |
| | Electives: | | | | | | | | |
| SI301 | Radoslav Galić, PhD, Full Professor | Discrete Mathematics | 2 | 2 | 0 | 0 | 4 | | |
| SEIRA301 | Damir Šljivac, PhD, Associate Professor, | Fundamentals of Power Engineering | 2 | 2 | 0 | 0 | 4 | | |
| SRIA301 | Slavko Rupčić, MSc, Senior Lecturer | Fundamentals of Digital Communications | 2 | 1 | 1 | 0 | 4 | | |
| **Branch: Power Engineering** | | | | | | | | | |
| SAEIR301 | Damir Karavidović, BSc, Lecturer | Measurements in Electrical Engineering | 3 | 1 | 2 | 0 | 6 | 1 | 7.5 |
| SEIRA301 | Damir Šljivac, PhD, Assistant Professor, | Fundamentals of Power Engineering | 2 | 2 | 0 | 0 | 4 | 1 | 6 |
| SE301 | Božidar Ivšinović, PhD, Lecturer | Fundamentals of Electrical Machines | 2 | 1 | 0 | 1 | 4 | 1 | 5.5 |
| SE302 | Zoran Kovač,MSc, Senior Lecturer | Electrical Installations, Equipment and Lightning | 2 | 1 | 0 | 1 | 4 | 1 | 5.5 |
| | | Elective course | | | | | 4 | 1 | 5.5 |
| | | **TOTAL:** | **9** | **5** | **2** | **2** | **26** | **5** | **30** |
| | Electives: | | | | | | | | |
| SI301 | Radoslav Galić, PhD, Full Professor | Discrete Mathematics | 2 | 2 | 0 | 0 | 4 | | |
| SIE301 | Marinko Stojkov, PhD, Assistant Professor | Power Circuit Switching Devices | 2 | 1 | 1 | 0 | 4 | | |
| SARIE301 | Željko Hocenski, PhD, Full Professor | Computer System Architecture | 3 | 1 | 1 | 0 | 5 | | |
| SAIER301 | Dražen Slišković, PhD, Assistant Professor; | Basics of Automatic Control | 2 | 1 | 1 | 0 | 4 | | |
| **Branch: Computer Engineering** | | | | | | | | | |
| SAR301 | Goran Martinović, PhD, Assitant Professor | Digital Electronics | 3 | 0 | 2 | 0 | 5 | 1 | 6 |
| SRIA301 | Slavko Rupčić, MSc, Senior Lecturer | Fundamentals of Digital Communications | 2 | 1 | 1 | 0 | 4 | 1 | 6 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SARIE301 | Željko Hocenski, PhD, Full Professor | Computer System Architecture | 3 | 1 | 1 | 0 | 5 | 1 | 6.5 |
| SR301 | Drago Žagar, PhD, Associate Professor | Information and Information Systems | 2 | 1 | 1 | 0 | 4 | 1 | 6.5 |
| | | Elective course | | | | | 4 | 1 | 5 |
| | | **TOTAL:** | **12** | **3** | **6** | **0** | **25** | **6** | **30** |
| | Electives: | | | | | | | | |
| SI301 | Radoslav Galić, PhD, Full Professor | Discrete Mathematics | 2 | 2 | 0 | 0 | 4 | | |
| SEIRA301 | Damir Šljivac, PhD, Associate Professor, | Fundamentals of Power Engineering | 2 | 2 | 0 | 0 | 4 | | |
| SAIER301 | Dražen Slišković, PhD, Assistant Professor; | Basics of Automatic Control | 2 | 1 | 1 | 0 | 4 | | |
| SAEIR301 | Damir Karavidović, BSc, Lecturer | Measurements in Electrical Engineering | 3 | 1 | 2 | 0 | 6 | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| S304 | Željko Širić, Senior Lecturer | Physical Education III | 0 | 0 | 2 | 0 | 2 | | |
| | Optional course: | | | | | | | | |
| SF301 | Branka Pavlović, MA, Senior Lecturer, Ivanka Ferčec, BA, Senior Lecturer | Foreign Language III | 1 | 1 | 0 | 0 | 2 | | |

**Semester 4**

| **Code** | ***Lecturer*** | ***Course*** | ***Weekly workload*** | | | | | ***Examination*** | ***ECTS credits*** |
|---|---|---|---|---|---|---|---|---|---|
| | | | P | A | L | K | Σ | | |
| S401 | Zlatko Lacković, PhD, Associate Professor | Introduction to Economics and Management | 2 | 1 | 0 | 0 | 3 | 1 | 5 |
| S402 | Tomislav Mrčela, PhD Associate Professor | Practical Training | | | | | 24 | 1 | 20 |
| **Branch: Computer Engineering** | | | | | | | | | |
| SRIA301 | Goran Martinović, PhD, Assistant Professor | Operating Systems | 2 | 0 | 2 | 0 | 4 | 1 | 5 |
| | | **TOTAL:** | **4** | **1** | **2** | **24** | **31** | **3** | **30** |
| **Branch: Automation**<br>**Branch: Power Engineering** | | | | | | | | | |
| SAE401 | Antun Pintarić, PhD, Associate Professor | Materials and Production Processes | 2 | 0 | 1 | 0 | 3 | 1 | 7 |
| | | **TOTAL:** | **4** | **1** | **1** | **24** | **30** | **3** | **30** |

**3th Year**

**Semester 5**

| **Branch: Automation** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Code** | ***Lecturer*** | ***Course*** | ***Weekly workload*** | | | | | ***Examination*** | ***ECTS credits*** |
| | | | P | A | L | K | Σ | | |
| SA501 | Dražen Slišković, PhD, Assistant Professor; | Automatic Control | 3 | 1 | 1 | 0 | 5 | 1 | 6.5 |
| SA502 | Božidar Ivšinović, PhD, Lecturer | Electrical Machines and Electric Drives | 3 | 1 | 1 | 0 | 5 | 1 | 6 |
| SAIR501 | Dražen Slišković, PhD, Assistant Professor | Microcomputers in Automation | 3 | 0 | 2 | 0 | 5 | 1 | 6.5 |
| SAR501 | Drago Žagar, PhD, Associate Professor | Computer and Communication Networks | 3 | 1 | 1 | 0 | 5 | 1 | 6 |
| | | Elective course | | | | | 4 | 1 | 5 |
| | | **TOTAL:** | **12** | **3** | **5** | **0** | **24** | **5** | **30** |
| | Electives: | | | | | | | | |
| SI501 | Antun Pintarić, PhD, Associate Professor | Recycling of Electrical Waste | 2 | 1 | 1 | 0 | 4 | | |
| SI502 | Srete Nikolovski, PhD, Full Professor | Computers in Power Engineering | 2 | 1 | 1 | 0 | 4 | | |
| SEIA501 | Ivan Flegar, PhD, Full Professor | Power Electronics | 3 | 1 | 1 | 0 | 5 | | |
| **Branch: Power Engineering** | | | | | | | | | |
| SEIA501 | Ivan Flegar, PhD, Full Professor | Power Electronics | 3 | 1 | 1 | 0 | 5 | 1 | 6 |
| SE501 | Zoran Kovač, MSc, Senior Lecturer | Power Switching Substations | 2 | 1 | 0 | 2 | 5 | 1 | 6.5 |
| SE502 | Srete Nikolovski, PhD, Full Professor | Power Networks and Lines | 2 | 1 | 1 | 0 | 4 | 1 | 5.5 |
| SE503 | Milica Pužar, MSc, Senior Lecturer | Transformers and Electrical Rotating Machines | 3 | 1 | 2 | 0 | 6 | 1 | 7 |
| | | Elective course | 2 | 1 | 1 | 0 | 4 | 1 | 5 |
| | | **TOTAL:** | **12** | **5** | **5** | **2** | **24** | **5** | **30** |
| | Electives: | | | | | | | | |
| SI501 | Antun Pintarić, PhD, Assistant Professor | Recycling of Electrical Waste | 2 | 1 | 1 | 0 | 4 | | |
| SI502 | Srete Nikolovski, PhD, Full Professor | Computers in Power Engineering | 2 | 1 | 1 | 0 | 4 | | |
| **Branch:Computer Engineering** | | | | | | | | | |
| SR501 | Davor Antonić, PhD, Associate Professor | Web Programming | 2 | 1 | 2 | 0 | 5 | 1 | 6.5 |
| SR502 | Ninoslav Slavek, PhD, Assistant Professor | Data Bases | 2 | 1 | 2 | 0 | 5 | 1 | 6.5 |
| SR503 | Davor Antonić, PhD, Associate Professor | Object-oriented Programming | 2 | 1 | 2 | 0 | 5 | 1 | 6.5 |
| SAR501 | Drago Žagar, PhD, Associate Professor | Computer and Communication Networks | 3 | 1 | 1 | 0 | 5 | 1 | 6 |
| | | Elective course | | | | | 4 | 1 | 4.5 |
| | | **TOTAL:** | **9** | **4** | **7** | **0** | **24** | **5** | **30** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Electives: | | | | | | | | |
| SI501 | Antun Pintarić, PhD, Associate Professor | Recycling of Electrical Waste | 2 | 1 | 1 | 0 | 4 | | |
| SI502 | Srete Nikolovski, PhD, Full Professor | Computers in Power Engineering | 2 | 1 | 1 | 0 | 4 | | |
| SAIR501 | Dražen Slišković, PhD, Assistant Professor | Microcomputers in Automation | 3 | 0 | 2 | 0 | 5 | | |

**Semester 6**

| **Branch: Automation** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Code** | ***Lecturer*** | ***Course*** | ***Weekly workload*** | | | | | ***Examination*** | ***ECTS credits*** |
| | | | P | A | L | K | Σ | | |
| SAIE601 | Dražen Dorić, MSc, Senior Lecturer | Process Measurements, Sensors and Actuators | 3 | 1 | 1 | 0 | 5 | 1 | 5.5 |
| SAIR601 | Dražen Slišković, PhD, Associate Professor | Automation Technique | 3 | 0 | 2 | 0 | 5 | 1 | 5.5 |
| | | Elective course | | | | | 4 | 1 | 5 |
| SD601 | | Final work | | | | 10 | 10 | 1 | 14 |
| | | **TOTAL:** | **6** | **1** | **3** | **10** | **24** | **4** | **30** |
| | Electives: | | | | | | | | |
| SIA601 | Robert Cupec, PhD, Assistant Professo | Introduction to Robotics and Intelligent Control | 2 | 1 | 1 | 0 | 4 | | |
| SIAE601 | Pavle Filko, PhD, Senior Lecturer | Electric Power Substations Control | 2 | 1 | 1 | 0 | 4 | | |
| SRIA601 | Slavko Rupčić, MSc, Senior Lecturer | Digital Communication Systems | 3 | 1 | 1 | 0 | 5 | | |
| **Branch: Power Engineering** | | | | | | | | | |
| SE601 | Zdravko Valter, PhD, Full Professor | Electric Drives | 3 | 1 | 1 | 0 | 5 | 1 | 5.5 |
| SE602 | Damir Šljivac, PhD, Assistant Professor | Power Plants and Power System | 3 | 1 | 1 | 0 | 5 | 1 | 5.5 |
| | | Elective course | 2 | 1 | 1 | 0 | 4 | 1 | 5 |
| SD601 | | Final work | | | | 10 | 10 | 1 | 14 |
| | | **TOTAL:** | **8** | **3** | **3** | **10** | **24** | **4** | **30** |
| | Electives: | | | | | | | | |
| SIE601 | Damir Karavidović, BSc, Lecturer | Power System Protection | 3 | 1 | 0 | 0 | 4 | | |
| SIE602 | Branko Štefić, BSc, Lecturer Željko Novinc, PhD, Senior Lecturer | Transmission and Distribution of Electrical Energy | 2 | 1 | 1 | 0 | 4 | | |
| SAIE601 | Dražen Dorić, MSc, Senior Lecturer | Process Measurements, Sensors and Actuators | 3 | 1 | 1 | 0 | 5 | | |
| SIAE601 | Pavle Filko, PhD, Senior Lecturer | Electric Power Substations Control | 2 | 1 | 1 | 0 | 4 | | |
| **Branch: Computer Engineering** | | | | | | | | | |
| SR601 | Snježana Rimac-Drlje, PhD, Associate Professor | Multimedia Technique | 3 | 0 | 1 | 1 | 5 | 1 | 5.5 |
| SRIA601 | Slavko Rupčić, MSc, Senior Lecturer | Digital Communication Systems | 3 | 1 | 1 | 0 | 5 | 1 | 5.5 |
| | | Elective course | | | | | 4 | 1 | 5 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SD601 | | Final work | | | | 10 | 10 | 1 | 14 |
| | | **TOTAL:** | **6** | **1** | **2** | **11** | **24** | **4** | **30** |
| | Electives: | | | | | | | | |
| SIR601 | Ninoslav Slavek, PhD, Assistant Professor | Software Design and Programming | 2 | 0 | 2 | 0 | 4 | | |
| SIR602 | Drago Žagar PhD, Associate Professor | Coding and Information Protection | 3 | 1 | 1 | 0 | 5 | | |
| SAIR601 | Dražen Slišković, PhD, Assistant Professor | Automation Technique | 3 | 0 | 2 | 0 | 5 | | |

## 3.2. Application-oriented study programme in Electrical Engineering - Courses description

# Semester 1

| S101 | Calculus I |
|---|---|
| ***Lecturer:*** | Radoslav Galić, PhD, Full Professor |
| ***Course description:***<br>Function. Graph of a function. Composite function. Inverse function. Elementary functions (polynomial, rational function, exponential and logarithmic function, power function, trigonometric and inverse trigonometric functions, hyperbolas and area functions). Sequences. Convergence of sequences. Basic theorems on convergence. Limits and continuity of functions. Asymptotes. Derivative of a function. Derivative as velocity. Derivative and the tangent. Differential. Derivatives of elementary functions. Rules of differentiation. Derivatives of composite functions. Higher derivatives. Basic theorems of differential calculus (Fermat's, Rolle's, Langrange's, Cauchy's theorem). Taylor's theorem. Approximation functions by a polynomial. Local extremes. Convexity, concavity and inflection points. Curvature. L'Hospital's rule. Methods for numerical solution of equations (direct and iterative methods).<br>Vector as a class of directed line segments. Addition of vectors. Multiplication of a vector by a scalar. Vector space. Basis of a vector space. Scalar product. Vector product. System of linear equations. Gaussian elimination method. Matrix representation of a system of linear equations. Theorem of Kronecker-Capelli. A set of solutions to equation F(x,y)=0: circle, ellipse, parabola, hyperbola. | |
| ***Knowledge and skills acquired:***<br>Students will be introduced to fundamental concepts and simple applications of functions, differential and vector calculus as well as principles of solving a system of linear equations. They will also be trained and prepared for long-life learning and use of mathematical structures, relations and operations as application tools. | |
| ***Teaching methods:***<br>Students are obliged to attend both lectures and problem solving exercises. | |
| ***Student assessment:***<br>During the semester students can take several tests which replace the written examination. This ensures continuous assessment of students' work and knowledge. | |
| ***Obligatory literature:***<br>1. R. Galić, M. Crnjac, I. Galić; Matematika za stručne studije, ETF Osijek i Veleučilište Požega. | |
| ***Recommended additional literature:***<br>1. B. Apsen, Repetitorij više matematike, Tehnička knjiga, Zagreb, 2000.<br>2. R. Scitovski, D. Jukić, Matematika, Matematički odjel, Osijek, 2001. | |
| ***ECTS credits:*** **6 ECTS credits**<br>An ECTS credit value has been added according to calculation of time required for studying and successful course completion. | |
| ***Examination methods:***<br>The final examination consists of the written and the oral part. Students can take the final examination after the completion of lectures and problem solving exercises. | |
| ***Course assessment:***<br>Conducting an anonymous questionnaire filled in by students after course completion, an analysis of students' final assessments and their overall success. | |

| S102 | Fundamentals of Computer System Implementation |
|---|---|
| ***Lecturer:*** | Ninoslav Slavek, PhD, Assistant Professor |
| ***Course description:***<br>History. Computer system development. Computer science. Data formats. Algorithms. Computer fundamentals. Computer system components. How a computer works. Operating systems: DOS, Unix, Windows. Package MS Office (Word, Excel, Power-Point, Access). Other software packages. Communication on the net: Outlook Express. Global net, Internet. Electronic mail. Web pages. Utility programs: Explorer. Anti-virus aids. Computer ethics. | |
| ***Knowledge and skills acquired:***<br>Basic knowledge of computer hardware. Basic knowledge of the system and application software. Basic knowledge of programming. | |

***Teaching methods:***

Lectures are not obligatory. Laboratory practice is obligatory.

***Student assessment:***

Successful completion of laboratory practice, tests and oral examination.

***Obligatory literature:***

1. D. Grundler, Primijenjeno računalstvo, Graphis, Zagreb, 2000.
2. R. Pressman: Software engineering, McGraw-Hill N.Y., 1995 Addison Wesley, Menlo Prk, Cal., 1994.
3. W. Humphrey: Managing the Software Process, Addison-Wesley 1990.
4. B. Motik, J. Šribar, Demistificirani C++, Element, Zagreb, 1997.

***Recommended additional literature:***

1. L. Budin, Informatika za 1. razred gimnazije, Element, Zagreb, 1997.
2. D. Patterson, J. Hennessy, Computer Organization and Design: The Hardware / Software Interface (2nd Edition), Morgan Kaufmann Publ., San Francisco, 1997.

***ECTS credits:*** **5 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Written and oral examination.

***Course assessment:***

During and at the end of the semester an anonymous questionnaire will be conducted in which students will evaluate the course itself as well as lecturers participating in the course teaching.

| **S103** | **Physics** |
|---|---|

***Lecturer:*** Željka Mioković, PhD, College Professor

***Course description:***

Introduction: Physics and measurement; Vectors and scalars (coordinate systems and frames of reference, vector and unit vector components). Mechanics: motion in one-dimension; one-dimensional motion with constant acceleration, freely falling bodies; motion in two-dimensions, circular motion; Newton's laws, (non)inertial systems, some applications of Newton's laws, fundamental forces in nature, Newton's universal law of gravity, work and energy, Conservation's law of linear momentum and energy; Rotation of a rigid body about a fixed axis; Mechanics of fluids. Thermodynamics: heat, temperature, thermal expansion of matter, ideal and real gases, molecular-kinetic theory of gases, laws of thermodynamics, heat transfer. Oscillations and wave motion; sound waves; electromagnetic waves, nature of the light, laws of geometric optics, interference, diffraction and polarisation of the light. Introduction to Quantum Physics: Blackbody radiation, photoelectric effect, the Bohr theory of the hydrogen atom, atomic spectra.

***Knowledge and skills acquired:***

Knowledge of the concepts and mathematically formulated physical laws which enables students to understand some phenomena in the nature and technology. Ability to solve simple problems in physics independently.

***Teaching methods:***

Lectures, problem solving, laboratory practice.

***Student assessment:***

Laboratory test, written and oral examination.

***Obligatory literature:***

1. P. Kulišić, Mehanika i toplina, Šk. knjiga, Zagreb, 1985.
2. V. Henč-Bartolić, P. Kulišić, Valovi i optika, Šk. knjiga, Zagreb, 1991.
3. P. Kulišić i dr., Riješeni zadaci iz mehanike i topline, Šk. knjiga, Zagreb, 1985.
4. V. Henč-Bartolić, P. Kulišić, Riješeni zadaci iz valova i optike, Šk. knjiga, Zagreb, 1991.

***Recommended additional literature:***

1. N. Cindro, Fizika 1, mehanika, valovi i toplina, Šk. knjiga, Zagreb, 1991.
2. Berkeley Physics Course, Vol. 1, 4. Tehnička knjiga, Zagreb, 1983.

***ECTS credits:*** **5.5 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Written and oral examination.

***Course assessment:***

Permanent communication with students.

| S104 | Engineering Graphics |
|---|---|
| ***Lecturer:*** | Tomislav Mrčela, PhD, Associate Professor |

***Course description:***
Orthogonal and axiomatic projections, cross-sections. Lines, technical script, paper formats. Draft and draft methods. Dimensions of models. Graphical interpretation in space and plane. Isometry. Norms and rules pertaining to construction and usage of technical documentations. Drawing selection and caption. Tolerances and endorsement. Meaning and options of graphical communication in electrical engineering. Basic symbols of electrical, electronic, electromechanical elements and systems. Types, design and usage of schemes in electrical engineering. Flowchart. Operation, electrical, connection schemes, access plan. Diagrams of logical systems and drawing methods. Connection schemes. Textual documentation. Technical description, manuals. Description of components and rules of using CAD systems. Using CAE systems in projects concerning electric power system and additional documentation. Introduction to electronic system documentation (systems, facilities) using the CAD computer programme. Exercises: Fundamentals of design and making documentation by means of a computer. Working in the AutoCAD programme applications. Marking elements according to IEC standards.

***Knowledge and skills acquired:***
During the course students acquire general knowledge of graphical display of three-dimensional systems, as well as specific knowledge pertaining to norms and standards used in design of electrical systems.

***Teaching methods:***
Lectures, practice.

***Student assessment:***
Partial examination.

***Obligatory literature:***
1. F. E. Giesecke, A. Mitchell, H.C. Spencer, I.L. Hill, J.T. Dygton: Technical Drawing, Macmillan Publishing company, New York, 1986.

***Recommended additional literature:***
1. J. H. Earle. Graphics for Engineers, Addison-Wesley Publishing Company, New York, 1999.

***ECTS credits:*** **4 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
The course can be successfully completed either during the semester by taking two preliminary examinations or after the semester end by taking the written and the oral examination.

***Course assessment:***
During the semester and at the semester end students evaluate teaching successfulness by anonymous questionnaires.

| S105-E | Foreign Language I – English I |
|---|---|
| ***Lecturer:*** | Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Senior Lecturer |

***Course description:***
Atom. Interaction in Atomic Systems. Conducting and Insulating Materials in Electrical Engineering. Magnetic Materials and Electromagnetism. Some Basic Notions Concerning Energy. Electromotive Force and Power. Characteristics of Capacitance. Lenz's Law -Inductance. Ohm's Law - Resistance. The A - C Cycle.

***Knowledge and skills acquired:***
Reading and understanding texts from the field of electrical engineering, acquisition of new ESP vocabulary, broadening of knowledge pertaining to new structures typical of the English language (with special attention paid to Technical English), broadening and acquisition of new verbal and non-verbal communication patterns.

***Teaching methods:***
Lectures and language practice include terminology relative to fundamental fields of students' future profession, basic grammatical structures of the English language, as well as ESP characteristics necessary for basic speech acts.

***Student assessment:***
Individual homework or group task projects, regular communication, exercises, written and oral examination.

***Obligatory literature:***
1. Bartolić, Lj. Technical English in Electronics and Electrical Power Engineering, Školska knjiga, Zagreb, 1994.

***Recommended additional literature:***

1. R.Murphy, English Grammar in Use, CUP, Cambridge, 1995.

***ECTS credits:*** **2 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Written and oral examination.

***Course assessment:***

Conducting an anonymous questionnaire filled in by students after course completion, an analysis of students' final assessments and their overall success.

| S105-NJ | Foreign language I – German I |
|---|---|

***Lecturer:*** Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Senior Lecturer

***Course description:***

Mathematik, Grössen, Einheiten und Kurzzeichen, Das Verwirrspiel bei den Massen und Gewichten, Grundbegriffe, Energiebegriffe, Energieformen, Energieumwandlung, Weg der elektrischen Energie.

***Knowledge and skills acquired:***

Reading and understanding texts from the field of electrical engineering, acquisition of new ESP vocabulary, broadening of knowledge pertaining to new structures typical of the German language used in electrical engineering, broadening and acquisition of new verbal and non-verbal communication patterns.

***Teaching methods:***

Lectures and language practice.

***Student assessment:***

Written and oral examination.

***Obligatory literature:***

1. V. Grujoski: Deutsche Fachtexte aus der Elektrotechnik

***Recommended additional literature:***

1. Medić: Kleine deutsche Grammatik

***ECTS credits:*** **2 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Written and oral examination.

***Course assessment:***

Students' evaluation at the course end.

## Branch: *Computer Engineering*

| SR101 | Fundamentals of Electrical Engineering |
|---|---|

***Lecturer:*** Božidar Ivšinović, PhD, Lecturer

***Course description:***

Structure of matter and electrical charge. Electrical field. Imaging with field lines. Electrical potential and voltage. On capacitance, capacitance of plane capacitors. Energy in electrostatic field. Electric circuit, intensity, direction and density of current. Electricity and conductance, influence of temperature. Ohm's law. Kirchhoff's laws. Power and energy in circuits, Joule's law. Maximum of usable power and efficiency. Magnetic field. Force on a moving charge. Density of the magnetic flux, the magnetic field vector, magnetic flux. Ampere's law. Permeability, ferromagnetism, magnetisation curve and hysteresis loop. Magnetic field around a linear conductor. Vector superposition. Faraday's law. Inductance and mutual inductance. Energy of the magnetic field. Currents and voltages changing in time. Basic effects of alternating currents. Average and RMS values. Current and voltage relations on resistor, capacitor, and inductor. Usage of complex calculation for analysis of sinusoidal current networks. Impedance and admittance. True, reactive and apparent power.

***Knowledge and skills acquired:***

Students will acquire knowledge of the fundamental laws in electromagnetism, units and measures of the electric and magnetic fields. Furthermore, they will be able to make analysis and measurements in simple DC and AC

circuits.

***Teaching methods:***

Lectures (3 hours per week), problem solving (2 hours), laboratory practice (1 hour)

***Student assessment:***

Written and oral examination, possibility of passing the examination by passing periodic tests.

***Obligatory literature:***

1. B. Kuzmanović, Osnove elektrotehnike I i II, Element, Zagreb, 2000.
2. Šehović, Felja, Tkalić, Osnove elektrotehnike, Zbirka primjera, Prvi dio, Školska knjiga, Zagreb, 1992.
3. Felja, Koračin, Malić, Zbirka zadataka i riješenih primjera iz Osnova elektrotehnike, I i II dio, 1991.

***Recommended additional literature:***

1. V. Pinter, Osnove elektrotehnike I i II, Tehnička knjiga, Zagreb, 1994.

***ECTS credits:*** **7.5 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Written and oral examination, possibility of passing the examination by passing periodic tests.

***Course assessment:***

Students' evaluation, analysis of laboratory practice and success scored on the written and the oral examination.

## Branch: *Power Engineering*
## Branch: *Automation*

| **SAE101** | **Fundamentals of Electrical Engineering I** |
|---|---|

***Lecturer:*** Milica Pužar, MSc, Senior Lecturer

***Course description:***

Structure of matter. Conductors and insulators. Coulomb's law. Electric field. Gauss's law. Electric potential and voltage. Electric circuit and electric current. Electric resistance. Ohm's law. Kirchhoff's laws. Power and energy in a current circuit, Joule's law. Methods and theorems for solving electric networks. Material in the electric field. Electric flux vector. Capacitance and capacitors. Energy of the electrostatic field. Electrostatic networks. Magnetic field, flux density and magnetic field intensity. Magnetic force on a current-carrying conductor. Biot-Savart's law. Ampere's law. Electromagnetic induction. Material in the magnetic field. Magnetic circuits. Self- and mutual inductance. Energy of the magnetic field. Laboratory practice: Work in the laboratory. Ohm's law, real sources and real instruments. Kirchhoff's laws, Thevenin's and Norton's equivalent model. Complex direct current networks. Electrostatic networks. Magnetic field and coil inductance. Faraday's law.

***Knowledge and skills acquired:***

Fundamental knowledge of electromagnetic phenomena required for following the study of professional courses in electrical engineering.

***Teaching methods:***

Lecturing by means of PowerPoint presentations, problem solving and laboratory practice with active participation of students by continuous assessment of the acquired knowledge.

***Student assessment:***

Continuous assessment during the course. Laboratory practice tests.

***Obligatory literature:***

1. V. Pinter: Osnove elektrotehnike I i II, Tehnička knjiga, Zagreb, 1989.
2. Šehović, Felja, Tkalić: Osnove elektrotehnike, Zbirka primjera, Prvi dio, Školska knjiga, Zagreb 1980.

***Recommended additional literature:***

1. Felja, Koračin, Zbirka zadataka i riješenih primjera iz osnova elektrotehnike, 1. dio, Školska knjiga, Zagreb, 1985.
2. B. Kuzmanović, Osnove elektrotehnike I i II, Element, Zagreb, 2001.
3. M.Pužar, I.Mandić, Osnove elektrotehnike I, lecture notes, Elektrotehnički fakutet Osijek, 2003.

***ECTS credits:*** **7.5 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Continuous assessment during the course, written and oral examination.

***Course assessment:***
Contact hours and a questionnaire.

## Semester 2

| S201 | Calculus II |
|---|---|
| ***Lecturer:*** | Radoslav Galić, PhD, Full Professor |

***Course description:***
Primitive of a function. Indefinite integral. Methods of integration: the method of substitution, integration by parts. Integration of rational functions. Riemann integral. Newton-Leibniz formulae. Trapezoid rule. Simpson's rule. , Length of the arc of a curve. Volume and surface of a solid of rotation. Problems in engineering referring to use of differential equations. Solution methods for differential equations. The existence theorem. Separation of variables. Homogenous differential equation. Linear differential equation of the first degree. Linear differential equation of the second degree with constant coefficients. Application of differential equations (simple harmonic oscillations, spring vibrations, damped vibrations, forced vibrations, simple electric networks). Numerical methods for solving differential equations. Series. Convergence of series. Criterion of convergence of the series with positive terms (comparison, d'Alembert, Cauchy's criterion). Leibniz's criterion for series with alternating signs. Convergence area. Power series. Convergence interval. Taylor and Mac Lauren series. Fourier series.

***Knowledge and skills acquired:***
Students will be introduced to fundamental concepts and simple applications of integral calculus, differential functions of series. They will also be trained and prepared for long-life learning and use of mathematical structures, relations and operations as application tools.

***Teaching methods:***
Students are obliged to attend both lectures and exercises.

***Student assessment:***
During the semester students can take several tests which replace the written examination. This ensures continuous assessment of students' work and knowledge.

***Obligatory literature:***
1. B. Apsen, Repetitorij više matematike, Tehnička knjiga, Zagreb, 2000.

***Recommended additional literature:***
1. R. Scitovski, D. Jukić, Matematika, Matematički odjel, Osijek, 2001.
2. P. Javor, Matematička analiza, Školska knjiga, Zagreb, 2000.

***ECTS credits:*** **7 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
The final examination consists of the written and the oral part. Students can take the final examination after the completion of lectures and problem solving exercises.

***Course assessment:***
Conducting an anonymous questionnaire filled in by students after course completion, an analysis of students' final assessments and their overall success.

| S202 | Mathematical Statistics |
|---|---|
| ***Lecturer:*** | Radoslav Galić, PhD, Full Professor |

***Course description***:
Algebra of events. Probability of events. Basic probability properties. Classic definition of probability. Conditional probability and independence. Discrete probabilistic space. Discrete random variable. Binominal and Poisson distribution. Continuous random variable. Normal distribution. Normal distribution parameters. t distribution. Empirical one-dimensional and two-dimensional distribution. Sample and parameter samples. Basic statistical methods. Statistical estimation theory. Statistical decision making. Hypotheses testing. Basics of correlation theory.

***Knowledge and skills acquired:***
Introduction to statistical terminology and laws, construction of statistical models and their application in engineering, process control, quality control and other problems. To prepare students for lifelong learning process and use of mathematical tools in application.

***Teaching methods:***
Lectures and solving statistical problems.

***Student assessment:***
During the semester students can take several tests which replace the written examination. This ensures a continuous assessment of students' work and knowledge.

***Obligatory literature:***
R. Galić, Vjerojatnost, ETF, Osijek, 2004.
R: Galić, Statistika, ETF, Osijek, 2004.

***Recommended additional literature:***
I. Pavlić, Statistička teorija i primjena, Tehnička knjiga, Zagreb, 2000.
Ž.Pauše, Uvod u matematičku statistiku, Školska knjiga, Zagreb,1993.
Ž.Pauše,Vjerojatnost, informacija, stohastički procesi, Školska knjiga, Zagreb, 1988.

***ECTS credits:*** **5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Seminar and oral examination.

***Course assessment:***
Conducting an anonymous questionnaire filled in by students after course completion, an analysis of students' final assessments and their overall success.

| S203 | Fundamentals of Electronics |
|---|---|

***Lecturer:*** Slavko Rupčić, MSc, Senior Lecturer

***Course description:***
Physical fundamentals of semiconductors. Junction-diodes. Basic diode devices. Bipolar and unipolar transistors. Thyristors. Other semiconductor elements for switched operating modes. Fundamentals of amplifiers. Basic amplifiers with bipolar and unipolar transistors. Feedback Circuits (amplifiers). Power circuits and systems: class A, AB and B amplifiers. Operational amplifiers and basic circuits with operational amplifiers. Pulse electronic circuits: transistor switch, multivibrators, waveshaping and waveform generators.

***Knowledge and skills acquired:***
Students will acquire knowledge on how to analyse electronic devices in static and dynamic operating conditions.

***Teaching methods:***
Experimental practice examination. Oral and written examinations.

***Student assessment:***
Testing laboratory practice tasks, written and oral examinations.

***Obligatory literature:***
1. E.Kamen, Introduction to Signals and Systems, Macmillan Pub. Comp. New York, 1987.
2. Modlic, B.Modlic: Visokofrekvencijska elektronika - Modulacija, modulatori, sintezatori frekvencije, Školska knjiga, Zagreb, 1982.

***Recommended additional literature:***
1. G.Lukatela, Digitalne telekomunikacije, Građevinska knjiga, Beograd, 1988.
2. J.G.Proakis, Digital Communications, 4th ed., McGraw Hill, N.Y., 2000.

***ECTS credits:*** **7.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination.

***Course assessment:***
Students' questionnaires.

| S204-E | Foreign Language II – English II |
|---|---|

***Lecturer:*** Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Senior Lecturer

***Course description:***

Fundamentals of Transistor Physics. Transistors. Integrated Circuits. Introduction to Electric Power Systems. Switches, Circuit Breakers and Fuses. Conduction and Transmission of Electric Current. Transformers. Electric Generators and Motors. Characteristics of Electrical Machines. Measuring Instruments.

***Knowledge and skills acquired:***
Reading and understanding texts from the field of electrical engineering, acquisition of new ESP vocabulary, broadening of knowledge pertaining to new structures typical of the English language (with special attention paid to Technical English), broadening and acquisition of new verbal and non-verbal communication patterns.

***Teaching methods:***
Lectures and language practice include terminology relative to fundamental fields of students' future profession, basic grammatical structures of the English language, as well as ESP characteristics necessary for basic speech acts.

***Student assessment:***
Individual homework or group task projects, regular communication, language practice, written and oral examination.

***Obligatory literature:***
1. Bartolić, Lj. Technical English in Electronics and Electrical Power Engineering, Školska knjiga, Zagreb, 1994.

***Recommended additional literature:***
1. R.Murphy, English Grammar in Use, CUP, Cambridge, 1995.

***ECTS credits:*** **3 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination.

***Course assessment:***
Conducting an anonymous questionnaire filled in by students after course completion, an analysis of students' final assessments and their overall success.

| S205-NJ | **Foreign language II – German** |
|---|---|

***Lecturer:*** Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Senior Lecturer

***Course description:***
Strom und Physik, Elektrizität und unser Alltag, Woher kommt der Strom?, Elektrische Unfälle und deren Verhütung, Farbfernsehen, Aus der Geschichte der Elektrotechnik.

***Knowledge and skills acquired:***
Reading comprehension of texts in the field of electrical engineering, acquiring new vocabulary, new syntactic structures, acquiring new communicative patterns.

***Teaching methods:***
Lectures and language practice.

***Student assessment:***
Written and oral examination.

***Obligatory literature:***
1. V. Grujoski: Deutsche Fachtexte aus der Elektrotechnik

***Recommended additional literature:***
1. Medić: Kleine deutsche Grammatik

***ECTS credits:*** **3 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination.

***Course assessment:***
Students' evaluation at the course end.

## Branch: *Computer Engineering*

| SR201 | Programming |
|---|---|
| ***Lecturer:*** | Davor Antonić, PhD, Associate Professor |
| ***Course description:*** Revision of C programming language basic elements. Complex data types: arrays, structures, unions. Pointers: relation to arrays, pointer arithmetics. Functions. Parameter passing by value and by reference. Files: binary, ASCII, sequential, random access. Software development principles, top-down and bottom-up approach. Algorithm, transformation into program code. Examples of searching and sorting algorithms. Basics of object-oriented programming. Class and object. Inheritance. | |
| ***Knowledge and skills acquired:*** Systematic approach to software development. Detail knowledge of C programming language. Basics of object-oriented programming. | |
| ***Teaching methods:*** Lectures, laboratory practice. | |
| ***Student assessment:*** Laboratory practice evaluation, tests. | |
| ***Obligatory literature:*** 1. Fischer, Zbirka zadataka iz C-a, ETF Osijek, 1999. 2. Motik, Šribar, Demistificirani C++ (2. izd.), Element, Zagreb, 2003. | |
| ***Recommended additional literature:*** 1. Kernighan, Ritchie, The C Programming Language, Prentice-Hall, Englewood Cliffs, NJ, 1996. 2. Knuth, The Art of Computer Programming, Vol. 1., Fundamental Algorithms, Addison-Wesley, Reading, MA, 1997. | |
| ***ECTS credits:*** **7.5 ECTS credits** An ECTS credit value has been added according to calculation of time required for studying and successful course completion. | |
| ***Examination methods:*** The final examination consists of the written and the oral part. Students can take the final examination after the completion of lectures and laboratory practice. | |
| ***Course assessment:*** Conducting an anonymous questionnaire filled in by students after course completion. | |

## Branch: *Power Engineering*
## Branch: *Automation*

| SAE201 | Fundamentals of Electrical Engineering II |
|---|---|
| ***Lecturer:*** | Milica Pužar, MSc, Senior Lecturer |
| ***Course description:*** Transients in RL and RC circuits. Periodic magnitudes. Complex numbers and phasor concept. Sinusoidal voltage on R, L and C. Impedance and admittance. Electric power and power factor. Resonance. Nonsinusoidal waves. Three-phase system. Transformer principles and equivalent circuit. Electromechanical energy conversion. Laboratory practice: Transients. Complex alternating current circuits and the power in electric networks. Impedance and resonance. Three-phase symmetric networks. Three-phase unsymmetric networks. Single-phase transformer. | |
| ***Knowledge and skills acquired:*** Acquisition of knowledge in electric alternating circuits required for the study of professional courses in electrical engineering. | |
| ***Teaching methods:*** Lecturing by means of PowerPoint presentations, problem solving and laboratory practice with active participation of students by continuous assessment of the acquired knowledge. | |
| ***Student assessment:*** Continuous assessment during the course. Laboratory practice tests. | |
| ***Obligatory literature:*** | |

1. V. Pinter: Osnove elektrotehnike I i II, Tehnička knjiga, Zagreb, 1989.
2. Felja, Koračin: Zbirka zadataka i riješenih primjera iz osnova elektrotehnike, 1 i 2 dio, Školska knjiga, Zagreb, 1985.

***Recommended additional literature:***

1. B. Kuzmanović, Osnove elektrotehnike I i II, Element, Zagreb, 2001.
2. M.Pužar, I.Mandić, Osnove elektrotehnike I, lecture notes, Elektrotehnički fakutet Osijek, 2003.

***ECTS credits:*** **7.5 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Continuous assessment during the course, written and oral examination.

***Course assessment:***

Contact hours and questionnaire.

| **S106, S205, S304** | **Physical Education I, II and III** |
|---|---|
| ***Lecturer:*** | Željko Širić, Senior Lecturer |

***Course description:***

Physical education is carried out according to four programmes:
1. Basic programme, 2. Programme for students of damaged health, 3. Programme of optional activities, 4. Programme of elective activities.
Course contents:
1. Basic programme

1. Apparatus gymnastics.

Warming-up exercises, without and with gymnastics apparatus. Apparatus exercises (parallel bars, stationary rings, etc.). Exercises on the floor (rolls, forward horizontal stand, positions, postures, etc.)

2. Ball games.

Basic elements of ball games (basketball, volleyball, football, handball, etc.)

3. Athletics.

Running (short-distance, middle-distance, cross-country run). Jumping: high jump, long jump. Shot put, discus throw.

2. Programme for students of damaged health

In case there are students of damaged health condition, the lecturer develops a special programme for each student of such group.

## Semester 3

| **SAEIR301** | **Measurements in Electrical Engineering** |
|---|---|
| ***Lecturer:*** | Damir Karavidović, BSc, Lecturer |

***Course description:***

This course covers the following topics: basic terms of measurement technique; measuring signals percipience in amplitude, time and frequency domain; measuring instruments of average and RMS value; basic principles of analogue and digital measuring methods; common features of analogue measurements and indication; examples of practical analogue measuring instruments; principles of digital signal processing and features of digital measuring instruments; measurement of basic electric variables; voltage and current measurement; waveform influence to measurement accuracy; power and energy measurement; measurement of electrical resistivity, impedance and reactance; power factor measurement; selected measurement methods; bridge and compensation measuring methods; about oscilloscope; oscilloscope measurement; Y-t and X-Y mode measurement of basic electric variables; special oscilloscope measurement; application of computer in measuring systems; measuring systems based on computer; measuring instrument computer communication; virtual instrumentation; measuring uncertainty, accuracy of measuring instruments and methods.

***Knowledge and skills acquired:***

Basic knowledge of metrology, measurement instruments, and measurement methods. Skills for correct measurements of basic electrical quantities. Knowledge to interpret instruments specifications, estimate measurement uncertainty, express complete measurement results and make decisions on the basis of complete measurement results. Skills to handle PC based measuring systems.

***Teaching methods:***

Lectures, problem solving and laboratory practice.

***Student assessment:***

Preliminary, written and oral examination.

***Obligatory literature:***

1. D. Karavidović: Električna mjerenja -1 i 2, Sveučilište u Osijeku, 1990.
2. D. Karavidović. Zbirka zadatak, skripta, Elektrotehnički fakultet, 2005.
3. D. Karavidović, D. Dorić: Upute za laboratorijske vježbe iz električnih mjerenja, Elektrotehnički fakultet, 1998.

***Recommended additional literature:***

***ECTS credits:*** **7.5 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Written and oral examination.

***Course assessment:***

At the end of semester an official questionnaire can be conducted referring to students' evaluation of the course teaching and lecturers participating in course teaching.

| **SARIE301** | **Computer System Architecture** |
|---|---|

***Lecturer:*** Željko Hocenski, PhD, Full Professor

***Course description:***

Microprocessor and microcomputer. Personal computer. Intel microprocessor architecture. System busses (AT/ISA, SCSI, PCI, etc.). Functional parts of computer. Data formats. Microcomputer operation. Instruction set. Addressing modes. Instruction execution time. Memory devices. Semiconductor memories. External storage: Magnetic and optic media. Memory management. Input-output functional units. Parallel input/output interface (PIO, Centronics). Direct memory access (DMA). Timing circuits and devices (CTC). Serial interface (UART, SIO). Serial busses and protocols (RS-232, RS-485, USB, IEEE-1394,IIC, etc.). MODEM. Basic input/output methods: Cyclic and event driven. Interrupt system. Software development and tools. Operating system. File system. Supervision and diagnostic circuits. Microcontrollers. Local network. Internet. Modern microprocessor and computer architecture (RISC, CISC). Pipelines. Modern microprocessor examples. Multiprocessor systems.

***Knowledge and skills acquired:***

Using lectures and individual work a student acquires knowledge of computer architecture, microprocessor and microprocessor systems, technological characteristics and production specifications. Students learn how to recognise specific computer design problems and solving methods. Skills of applying modern software tools for hardware and software design, simulation and verification are obtained, such as digital oscilloscopes, EPROM, PAL and GAL programming tools, logic analysers, software tools for digital design (such as MicroSim, OrCAD, Cadence etc), equipment and tools for microprocessor system development as emulators, etc.

***Teaching methods:***

- Lectures using multimedia presentations
- Individual learning using CD ROM
- E-learning using multimedia programs like WebCT
- Reading papers
- Exercises with solved problems
- Individual problem solving and team work
- Laboratory practice on ready-made models and construction of students' own simple circuits and devices

***Student assessment:***

Solving simple individual problems and team work on more complex problems.
On-line testing using e-learning tools like WebCT with questions data base.
Assessment of laboratory work and estimation of design, construction, testing and presentation of students' own simple circuits and devices.
Oral examination with students for the purpose of defining the final grade.

***Obligatory literature:***

1. Ž. Hocenski, Arhitektura računala, ETF Osijek, 2005.

2. Ž. Hocenski, G.Martinović, M.Antunović, Arhitektura računala - Priručnik za laboratorijske vježbe, ETF Osijek, 2005.
3. R.Williams, Computer Systems Architecture, Addison Wesley, 2001.

***Recommended additional literature:***

1. S. Ribarić: Arhitektura računala, Školska knjiga, Zagreb, 1990.
2. B.B. Brey, The Intel Microprocessors 8086-8088, 80186-80188, 80286, 80386, 80486, Pentium Pro Processor and Pentium II, Architecture, Programming and Interfacing, Prentice Hall, 2000.
3. J.D.Carpinelli, Computer Systems Organization & Architecture, Addison Wesley, 2001.

***ECTS credits:*** **6.5 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Assessment of knowledge during lectures and individual problem solving and the oral examination.

***Course assessment:***

Attendance on lectures, practice and examinations.

| SR301 | Information and Information Systems |
|---|---|

***Lecturer:*** Drago Žagar, PhD, Associate Professor

***Course description:***

Historical importance of information and information systems. Nature and properties of information. Signal. Sign. Information levels and forms. Information sources: natural and artificial. Discrete information systems. Random events, information content and information source capacity. Entropy and entropy properties. Entropy by information transmission. Redundancy. Optimal coding. Prefix codes. Block codes. Information attributes of Marcov information sources. Discrete memoryless noisy communication channel. Channel capacity. Fundamental physical limits by information transmission. Noise. Limits of secure information transmission. Basic detecting and correcting codes. Continuous information sources and channels. Information volume.

***Knowledge and skills acquired:***

Students will become familiar with the fundamentals of Information theory that represent the basis for further studying of communications.

***Teaching methods:***

Lectures, problem solving, laboratory practice.

***Student assessment:***

Several tests during the semester, testing knowledge gained in laboratory practice, written and oral examination.

***Obligatory literature:***

1. V. Sinković, Teorija informacija, Školska knjiga , Zagreb, 1990.
2. V. Sinković, Informacija, simbolika i semantika, Školska knjiga , Zagreb, 1997.

***Recommended additional literature:***

1. N. Rožić, Informacija i komunikacije, kodiranje s primjenama, Alinea, Zagreb 1992.
2. F. Halsale: Data Communications, Computer Networks and Open Systems, Adison Wesley, 1996.

***ECTS credits:*** **6.5 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Written and oral examination.

***Course assessment:***

Students' examination by the end of the course.

| SF301-E | Foreign Language III – English III - optional |
|---|---|

***Lecturer:*** Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Senior Lecturer

***Course description:***

Introduction to computer science terminology. Computer applications. Configuration. Hardware vs. software. Memory. Buying a computer. Input devices. Output devices. Storage devices. Operating systems. The graphical user interface. Multimedia systems.

Electric power systems. Switching and transformer equipment. Construction and design of transformers. Transmission and distribution of electric current. Transmission lines. (Renewable) Energy resources. Types of power

plants.

***Knowledge and skills acquired:***
Reading and understanding texts from the field of computer science and/or electrical engineering, acquisition of new ESP vocabulary, broadening of knowledge pertaining to new structures typical of the English language, broadening and acquisition of new verbal and non-verbal communication patterns.

***Teaching methods:***
Lectures and language practice include terminology relative to fundamental fields of students' future profession, basic grammatical structures of the English language, as well as ESP characteristics necessary for basic speech acts.

***Student assessment:***
Individual homework or group task projects, regular communication, language practice, written and oral examination.

***Obligatory literature:***
1. Bartolić, Lj. Technical English in Electronics and Electrical Power Engineering, Školska knjiga, Zagreb, 1994.
2. Ferčec, I. A Course in Scientific English: Mathematics, Physics, Computer Science, Odjel za matematiku/Elektrotehnički fakultet, Osijek, 2001.

***Recommended additional literature:***
1. R.Murphy, English Grammar in Use, CUP, Cambridge, 1995.

***ECTS credits:*** **0 ECTS credits**
This course is optional.

***Examination methods:***
Written and oral examination.

***Course assessment:***
Conducting an anonymous questionnaire filled in by students after course completion, an analysis of students' final assessments and their overall success.

| **SF301-NJ** | **Foreign Language III – German III – optional** |
|---|---|
| ***Lecturer:*** | Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Senior Lecturer |

***Course description:***
Von der Windmühle zur Windkraftanlage, Einteilung und Eigenschaften der Werkstoffe, Prozessautomatisierung, Wie das Fernsehbild entsteht, Autofahrer Leit – und Informationssystem, Computer beim Autofahren, Elektronik – news

***Knowledge and skills acquired:***
Reading comprehension of texts in the field of electrical engineering, acquiring new vocabulary, new syntactic structures, acquiring new communicative patterns.

***Teaching methods:***
Lectures and language practice.

***Student assessment:***
Written and oral examination.

***Obligatory literature:***
1. V. Grujoski: Deutsche Fachtexte aus der Elektrotechnik

***Recommended additional literature:***
1. Medić: Kleine deutsche Grammatik

***ECTS credits:*** **0 ECTS credits**
This course is optional.

***Examination methods:***
Written and oral examination.

***Course assessment:***
Students' evaluation at the course end.

| SAR301 | Digital Electronics |
|---|---|
| ***Lecturer:*** | Željko Hocenski, PhD, Full Professor |

***Course description:***
Digital circuits and systems features. Development survey. Number systems and conversions. Digital arithmetics. Logic functions. Logic function simplification. Logic symbols and standards. Logic functions realisation. NAND and NOR logic. Integrated logic circuits. Modern logic circuit technologies and characteristics. Combination circuits. Integrated logic circuit examples. Sequential circuits. Asynchronous and synchronous flip-flops. Counters and dividers. Register types. Memories. Semiconductor memories: Bipolar and MOS. Static and dynamic RAM memories. Magnetic media. Optic media. Programmable logic circuits: features, programming and applications. Visual displays. A/D and D/A conversion. Microprocessors and microcontrollers. Digital circuits and systems software design tools. Development and testing of digital circuits and equipment. Digital circuits' reliability. Digital electronics diagnostics.

***Knowledge and skills acquired:***
Using lectures and individual work, students acquire basic knowledge in the field of digital integrated circuits and systems area, reasons of appearance, historical development, technological characteristics and production specifications. Students will learn how to recognise specific digital electronic problems and solving methods by using requirements specification in digital circuits and systems design. Skills in applying modern software tools for drawing logic diagrams, simulation and verification of logic circuits and systems are acquired. Design methods for logic circuits and structures by using integrated logic circuits, programmable logic circuits and microprocessor systems. Tools and instruments for development and diagnostics as logic probes, digital oscilloscopes, PAL and GAL programming tools, logic analysers, software tools for digital design (like MicroSim, OrCAD, Cadence etc).

***Teaching methods:***
Lectures using multimedia presentations. Individual learning using CD ROM. E-learning using multimedia programmes like WebCT. Reading written papers. Exercises with solved problems. Individual problem solving and team work. Laboratory practice on ready-made models and construction of own simple circuits and devices.

***Student assessment:***
- Solving simple individual problems and encouraging team work on more complex problems.
- On-line testing using e-learning tools like WebCT with questions data base.
- Assessment of work in laboratory and estimation of design, construction, testing and presentation of own simple circuits and devices.
- Oral examination with students for the purpose of defining the final grade.

***Obligatory literature:***
1. Ž. Hocenski, Digitalna elektronika, ETF Osijek, 2005.
2. U.Peruško, Digitalna elektronika, Školska knjiga, Zagreb, 1991.
3. Ž. Hocenski, G.Martinović, M.Antunović, Digitalna elektronika - Priručnik za laboratorijske vježbe, ETF Osijek, 2003.

***Recommended additional literature:***
1. D.C.Green, Digital electronics, Addison Wesley Longman, 1999.
2. R.L.Tokheim, Digital Principles, McGraw-Hill, 1988.

***ECTS credits:*** **6 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Knowledge assessment during the semester and individual problem solving and oral examination

***Course assessment:***
Lecture attendance, laboratory practice and examinations during the semester.

| SAIER301 | Basics of Automatic Control |
|---|---|
| ***Lecturer:*** | Dražen Slišković, PhD, Assistant Professor |

***Course description:***
Automatic control and its purpose. Basic terms and definitions. Basic structure and elements of the control loop. Implementation of a control system. Properties of controlled systems. Linearisation of characteristic curve. Dynamic behaviour of the system and its mathematical description. Description of linear, continuous and time invariant systems in time and frequency domain. Laplace transform and transfer function. Bode and Nyquist plot. Basic dynamic elements. Control loop and its characteristics. Control loop stability and methods of stability analysis.

Performance indexes in time and ferquency domain. Basic controller types. Control loop synthesis. Fixed set-point control. Classic methods of synthesis of linear continuous control systems. Synthesis in time and frequency domain. Empirical rules for setting the controller parameters. Practical examples. Principles of digital implementation of control systems.

***Knowledge and skills acquired:***
This course gives the basics of description of system dynamic behaviour, structural presentation of basic elements and systems of automatic control, feedback phenomenon in the system, and feedback system stability analysis. In addition to that, students acquire basic knowledge of control algorithm design and evaluation of the achieved control quality. Laboratory practice provides skills pertaining to use of basic software tools for control system analysis and synthesis (Matlab), as well as methodology of practical control system implementation.

***Teaching methods:***
Lectures, seminars and laboratory practice.

***Student assessment:***
Laboratory practice tests and final examination.

***Obligatory literature:***
1. Tomac, J.: Osnove automatske regulacije - predavanja, Fakultetska skripta, ETF, Osijek, 2004.

***Recommended additional literature:***
1. Perić, N.: Automatsko upravljanje - predavanja, Zavodska skripta, FER, Zagreb, 2004.
2. Šurina, T.: Automatska regulacija, Školska knjiga, Zagreb, 1991.
3. Franklin, G.F., J.D. Powell, A.E. Naeini: Feedback Control of Dynamic Systems, Addison - Wesley Publishing Company, 1994.

***ECTS credits:*** **5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Final examination consists of the written and the oral examination.

***Course assessment:***
Students' evaluation at the course end.

| **SI301** | **Discrete Mathematics** |
|---|---|

***Lecturer:*** Radoslav Galić, PhD, Full Professor

***Course description:***
Mathematical logic. Operations in logic. Truth tables. Tautolog. Predicate calculus. Whole numbers (integers). Divisibilty, prime numbers, congruence. Euler's function. Binary relations. Equivalence relations, set partition. Order relations, networks. Binary operations. Algebraic structures. Groups. Examples of finite groups. Rings. Rings of whole numbers (integers). Boolean algebras. Representation of Boolean algebra. Boolean functions. Combinatorics. Finite sets. Product of sets. Denumeration methods. Permutations. Permutation groups. Combinations. Variations. Recursion relations. Fibonacci sequence. Stirling number. Linear recursion formulae. Block designs. Finite projection planes.

***Knowledge and skills acquired:***
Students will be introduced to fundamental concepts and simple examples from the fields of logic, algebraic structures, relations and combinatorics. They will also be trained and prepared for long-life learning and use of mathematical structures, relations and operations as application tools.

***Teaching methods:***
Students are obliged to attend both lectures and exercises.

***Student assessment:***
During the semester students can take several tests which replace the written examination. This ensures continuous assessment of students' work and knowledge.

***Obligatory literature:***
1. D. Žubrinić, Diskretna matematika, Element, Zagreb,2001.

***Recommended additional literature:***
1. D. Veljan, Kombinatorna i diskretna matematika, Algoritam, Zagreb, 2001.
2. S. Lipschutz, Discrete Mathematics, McGraw Hill, New York, 1986.

***ECTS credits:*** **5.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course

completion.

***Examination methods:***
The final examination consists of the written and the oral part. Students can take the final examination after the completion of lectures and problem solving exercises.

***Course assessment:***
Conducting an anonymous questionnaire filled in by students after course completion, an analysis of students' final assessments and their overall success.

| **SEIRA301** | **Fundamentals of Power Engineering** |
|---|---|
| ***Lecturer:*** | Damir Šljivac, PhD, Assistant Professor |

***Course description:***
The importance of new energy sources. Forms and classification of new energy sources. Non-renewable new energy sources (oil, natural gas, nuclear and geothermal). Renewable new energy sources (hydro power, biomass, wind, solar and other). Basics of new energy transformations. Primary to useful energy conversion (chemical and nuclear energy conversion to internal thermal caloric energy, internal thermal caloric energy conversion to mechanical energy, mechanical energy conversion to electrical energy, direct energy conversions to the electrical energy, and electrical energy conversion to other energy forms). New energy sources for transportation. Storage for new energy sources. Total energy consumption and new energy sources contribution. Environmental impact of new energy sources. Life-cycle usage (pollution and climate change). Sustainable development and new energy sources (damage and benefit from energy use, savings and efficiency).

***Knowledge and skills acquired:***
Knowledge of most important energy sources and their impact on life. Understanding the importance and basics of energy conversions. Acquiring fundamental knowledge of energy modelling and planning for future energy needs considering benefits and damage.

***Teaching methods:***
Lectures and problem solving.

***Student assessment:***
Two control examinations.

***Obligatory literature:***
P. Kulišić: Novi izvori energije – sunčana energija i energija vjetra, Školska knjiga, 1991.
B. Udovičić: Energetika, Školska knjiga, Zagreb, 1993.
H. Požar: Osnove energetike 1, 2 i 3, Školska knjiga, Zagreb, 1992.

***Recommended additional literature:***
D. Feretić i suradnici: Elektrane i okoliš, Element, Zagreb, 2000.
V. Knapp: Novi izvori energije - nuklearna energija fisije i fuzije, Školska knjiga, 1993.

***ECTS credits:*** **6 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Control examinations and individual work or final examination

***Course assessment:***
Control examinations, questionnaire, discussion with students.

| **SE301** | **Fundamentals of Electrical Machines** |
|---|---|
| ***Lecturer:*** | Božidar Ivšinović, PhD, Lecturer |

***Course description:***
Classification and common characteristics. Fundamentals of mechanical energy conversion into electric energy and vice versa. Realisation of conversion. Magnetic circuit of electric machines. Machine models for DC voltages and DC current. Machine models for AC voltages and AC current. Current lining and flow. Flow of AC and polyphase excitation. Rotating magnetic field. Developed torque. Drive state.

***Knowledge and skills acquired:***
Knowledge of theoretical fundamentals, performances and modes of operation for electrical machines.

***Teaching methods:***

Lectures, problem solving and laboratory practice.

***Student assessment:***
Control tests.

***Obligatory literature:***
Wolf, R.: Osnove električnih strojeva, Školska knjiga, Zagreb 1991.
Dolenc, A. i dr.: Električni strojevi, TE/4 JLZ, Zagreb 1973.
Kelemen, T.: Transformator, TE/13 HLZ, Zagreb 1997.

***Recommended additional literature:***
Piotrovskij, L.M.: Električni strojevi, Tehnička knjiga, Zagreb 1970.

***ECTS credits:*** **5.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Test and oral examination.

***Course assessment:***
Conducting an anonymous questionnaire.

| SE302 | Electrical Installations, Equipment and Lighting |
|---|---|

***Lecturer:*** Zoran Kovač, PhD, Senior Lecturer

***Course description:***
Electrical energy demands. Consumption devices. Basic components in low current electrical lines, installation and equipment. Load flow calculation in radial lines and equipment: normal operation and short circuit. Short circuit, overload and overvoltage protection. Grounding. Danger voltage existing on device housing or other metal surfaces, differential current switch protection. Reactive power compensation. Electric lines, installation and equipment in houses, industrial and special buildings. Electric lines, installation and equipment in special industrial objects. Light measurments and space light distribution and units. Lamps, light sources, stabilisators and preconnection gadgets for light sources. Designing and calculation of indoors lighting, illumination measures and calculation, colour and spectrum diffusion, mixing and reproduction of colours, lighting calculation for spot and line light sources. Outdoor lighting, public lighting, application of isokandel diagram rules, composition of A, B and C planes for light space distribution, average merit, uniformity and strength of area illumination. Lamps, light armatures and towers for outdoor lighting, entrance or reflector lighting, reflectors. Ultraviolet radiation, calculation and usage of ultraviolet radiation and lighting economics.

***Knowledge and skills acquired:***
Electrical installation and equipment designing, calculations and graphics. Physical description of light, parameters and design principles.

***Teaching methods:***
Lectures and exercises.

***Student assessment:***
Seminar, written examination.

***Obligatory literature:***
1. N. Srb: Elektricne instalacije i niskonaponske mreze (Electrical Installations and Low Voltage Power Networks), Tehnicka knjiga Zagreb 1982.
2. "Koncar", Tehnicki prirucnik, V izdanje, Zagreb 1991.

***Recommended additional literature:***
1. Eduard Sirola: Cestovna rasvjeta, Grafika Hrasce, 1997. (Road Lighting);
2. Eduard Sirola: Javna rasvjeta, preporuke, Tehnicka knjiga Zagreb, 1979. (Public Lighting), symposium papers

***ECTS credits:*** **5.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination.

***Course assessment:***
Student´s questionnaire.

| SIE301 | Power Circuit Switching Devices |
|---|---|
| ***Lecturer:*** | Marinko Stojkov, PhD, Assistant Professor |

***Course description:***
Application, type and development of switching devices. Breaker, switch, contactor, disconnector and switchgear. Different construction conditions. Modern development tendencies. Switching network conditions. Switching phenomenon in short circuits. Switching of a three phase short circuit. Switching of asymmetrical short circuits. Influence of neutral grounding. Transient return voltage. Short circuits on short power lines. Load and switching operation in system (load factor influence). Single phase switching operation. Switching on and automatic restart with time delay. Switching of reactive current (current cutting phenomenon). Switching of capacitor bank. Electrical arc physics. Electrical arc in different matter. Electrical arc in vacuum. Electrical and magnetising arc characteristics. Heat signature of electrical arc. Switches - types of constructions, area of application, selection, mounting, maintenance and replacement. Air switches (pneumatic). Oil switches. SF6 switches. Vacuum switches. Disconnector. Fuse. Contactors. Surge arrestors. Switching devices remote operation and controll. Switching devices as a compact switchgear system.

***Knowledge and skills acquired:***
Physical description of arc phenomenon - generation, parameters and extinction. Defining switching devices characteristics and mounting locations of devices. Maintenance approaches and selecting devices during designing phase.

***Teaching methods:***
Lectures and exercises.

***Student assessment:***
Seminar.

***Obligatory literature:***
1. B.Belin: Uvod u teoriju električnih sklopnih aparata, Školska knjiga, Zagreb, 1978.

***Recommended additional literature:***
1. Flurscheim C.H.: Power Circuit Breakers - theory and design, Peter Peregrinus, Ltd., London 1975.
2. Ragaller K.: Current Interruption in HV Networks, Plenum Press, New York, 1980.
3. CIGRE WG 13.06, Final Report of the Second International Enquiry on High Voltage Circuit-Breaker Failures and Defects in Service, 1994.
4. Clegg B., Ewart G., Brankin F.: Advances in circuit breaker testing and condition monitoring, Proceedings IEE Monitors and condition assessment equipment, IEE digest No. 186, 1996.

***ECTS credits:*** **5.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination.

***Course assessment:***
Student´s questionnaire.

| SRIA301 | Fundamentals of Digital Communications |
|---|---|
| ***Lecturer:*** | Slavko Rupčić, MSc, PhD candidate, Senior Lecturer |

***Course description:***
Spectral and temporal analysis of digital signals. Noise sensitivity, digital signal formats, error detection and sinchronisation of digital signals. Digital signal sources. M-ary signal. Diskretisation of continuing signal: sampling, AD and DA conversion. Coding. Mapping. Nonlinear equalisation. Communication channels: wireless air propagation, Copper wire, telephone line, coaxial cable, IC interconnect, magnetic recording channels, optical fibre, other channels (ultra sound channel, power-line channel, undersea acoustic channel, etc.). Base-band transmission of digital signals. Intersymbol interference. Base-band transmission noise. Transpose-band transmission of digital signal. Noise in the digital communication systems. Filtering of digital signals. Channel capacity. Base-band transmission of digital signals: intersymbol interference, base-band transmission noise, eye diagram, filtering techniques, signalisation. Gain, phase and group delay distortion. Transpose-band transmission of digital signal. Noise in digital communication systems.

***Knowledge and skills acquired:***
Students will acquire knowledge of digital signals and problems related to propagation of signals in communication channels. They will also learn how to analyse noise influence on digital signals when these signals propagate in

different types of channels.

***Teaching methods:***

Lectures, problem solving, laboratory practice.

***Student assessment:***

Experimental work examination. Oral and written examaminations.

***Obligatory literature:***

1. E.Kamen, Introduction to Signals and Systems, Macmillan Pub. Comp. New York, 1987.
2. Modlic, B.Modlic: Visokofrekvencijska elektronika - Modulacija, modulatori, sintezatori frekvencije, Školska knjiga, Zagreb, 1982.

***Recommended additional literature:***

1. G.Lukatela, Digitalne telekomunikacije, Građevinska knjiga, Beograd, 1988.
2. J.G.Proakis, Digital Communications, 4th ed., McGraw Hill, N.Y., 2000.

***ECTS credits:*** **6 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Oral and written examination.

***Course assessment:***

Students' questionnaires.

## Semester 4

| S401 | Introduction to Economics and Management |
|---|---|

***Lecturer:*** Zlatko Lacković, PhD, Associate Professor

***Course description:***

1. Introduction: economics as a science, disciplines of economic science.
2. Procedures in economy: production, sharing, dealing and consumption.
3. Economic laws: rarety law, law of decreasing value adding, law of increasing relative costs.
4. Producing factors - (primary) human power, work, capital and land, (secondary) business organisation.
5. Production and national income, gross domestic product, national income and sharing.
6. Market: fundamental market terms; offer and demand, balance problems, monopoly and oligopoly.
7. Company: terms, sorts and managing, resources and finance;
8. Costs: terms, sorts and analysis.
9. Business score: balance, well and loss account, liquidaty account, indicators of bussiness success.
10. Prices, basic calculations, market prices.
11. Organisational structure of company.
12. Business politics in company
13. Basic terms of marketing, marketing mix, market research, developing products, promotion.
14. Managing quality, ISO 9000 standard.
15. Business plan for company.

During seminars topics are dealt with in detail and extensively explained

- through discussing examples,
- national economy in EU and in transition countries,
- huge business systems and small firms;
- visiting some fims in Osijek,
- through team/seminar work (based on a hypothetical firm) and elaborations.

***Knowledge and skills acquired:***

Students acquire basic knowledge of low resources and economic process in society and company necessary to understand the function of an engineer in practice. The acquired knowledge will represent an asset to students looking for successful business either in a small or a huge company, industry or service. The aim of the course is to teach students how to select business demands or tasks according to economic criteria; to make them ready for their own business, work based on marketing organisation and to prepare them for real social and economic practice.

***Teaching methods:***

Lectures and seminars.

***Student assessment:***
Examination.

***Obligatory literature:***
1. ZlatkoLacković - Malo poduzeće u tranziciji, Revnost, Osijek, 2000.

***Recommended additional literature:***
1. Samuelson, P.A., Nordhaus, W.D.: Ekonomija, (XIV. ed., McGraw-Hill )- MaTe, Zagreb, 1992.
2. Ivanović, M. Handbook of seminar topics on economics and management, ETF, Osijek, 2005.

***ECTS credits:*** **5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Oral examination.

***Course assessment:***
Insight into the written preparation of lectures and seminars.
Students' attendance.
Anonymous questionnaire at the end of the course.
Discussion of the examination passing rate and an average grade scored on examinations.

| S402 | **Practical Training** |
|---|---|

***Lecturer:*** Tomislav Mrčela, PhD, Associate Professor

***Course description:***
Practical training is an obligatory part of the programme students of the application-oriented study programme have during the fourth semester in duration of 24 hours a week (total of 3 working days). Each student is obliged to have individual practical training in the company doing the job relative to his/her course of study. Students will have tutors appointed to make them familiar with the organisational structure of the production and management system and production technology. On the other hand, students will themselves actively participate in all available engineering tasks, respecting the house rules of the host company. Students are obliged to keep the work record and at the same time to carry out the project task given by their respective tutors and verified by the practical training coordinator at the Faculty. Practical training is organised by the Faculty of Electrical Engineering in Osijek in cooperation with the graduated engineers employed in companies in the field of electrical engineering. These engineers are appointed as tutors by the Faculty and they jointly create and coordinate practical work of students in companies. As part of their practical training students can also work at various laboratories at the Faculty and participate as associates in projects run by the Faculty. Organisation of practical training is regulated by the Manual on practical training of students enrolled in the application-oriented study programme at the Faculty of Electrical Engineering. There is also an agreement on practical training for students of the Faculy signed with numerous companies.

***Knowledge and skills acquired:***
1. During their practical training students become familiar with: (a) the working environment in the production company, (b) organisational structure of the production and management system, (c) company management and their competencies, and (d) production technology of the company.
2. Students become familiar with and learn how to use the Measures and procedures on protection at work and the technology related to the host company in the line of their education
3. Students pass an exam on Protection at work and obtain an appropriate document.
4. By carrying out the specific project task related to the technology of the host company and in accordance with the specific profession students get a chance to apply their theoretical knowledge to practice, to improve their skills and to become capable of the practical work within the business sector.
5. Through writing the Report on practical training (and carrying out an appointed project) students improve their writing skills that will ease the process of writing the final report (examination).

***Teaching methods:***
Practical training carried out on a project task in a company.

***Student assessment:***
1. Grade earned in company referring to project task execution.
2. Final grade given by the lecturer in charge with practical training after student report.

***Obligatory literature:***

1. Rule book of practical training for students of the Faculty of Electrical Engineering in Osijek (ETF Osijek, 2005; available at www.etfos.hr)
2. Measures and procedures on protection at work in Croatia
3. Report on practical training (Osijek, 2005; available at www.etfos.hr)

***Recommended additional literature:***

***ECTS credits:*** **20 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

1. Execution of project task in company
2. Writing a report on practical training

***Course assessment:***

1. Week Reports the lecturer in charge with practical training submits to the dean of the Faculty of Electrical Engineering
2. Grade issued by the tutor in the company
3. Anonymous questionnaire at the course end.

## Branch: *Power Engineering*
## Branch: *Automation*

| **SAE401** | **Materials and Production Processes** |
|---|---|

***Lecturer:*** Antun Pintarić, PhD, Associate Professor

***Course description:***
Structure of crystals, amorphous, liquid crystals, polymers, ceramics. Structure of metals and alloys. Materials properties and testing – mechanical, electrical, magnetic, thermal and manufacturing. Diffusion. Conducting materials – low-resistivity conducting materials, high-resistivity conducting materials, thermoelements, thermocouple, contacts, circuit breakers. Superconductors. Semiconductors. Magnetic materials – soft and hard magnetic materials. Ferrites. Materials for thermo-magneto-optic memory. Electrical insulating materials. Polarisation. Inorganic, organic and compound insulating materials. Influence of manufacturing processes on properties. Fundamentals and applications of the methods of casting, chip removal, plastic deformation, heat treatment, powder metalurgy, joint technologies and materials. Manufacturing semiconductors and integrated circuit. Surface treatment. Processing of polymeric, composites and ceramic products.

***Knowledge and skills acquired:***
Understanding of the effective and efficient use of materials in engineering. Understanding of manufacturing processes, their comparative relationships and economics. Understanding relationship between material, process and product.

***Teaching methods:***
Lecture, laboratory practice, seminar.

***Student assessment:***
Seminar, final examination.

***Obligatory literature:***

1. W. D. Callister, Materials science and engineering: an introduction, John Wiley & Sons, New York, 2000.
2. V. Knapp, P. Colić, Uvod u električna i magnetska svojstva materijala, Školska knjiga Zagreb, 1990.
3. T. Filetin: Materijali i tehnologijski razvoj, Akademija tehničkih znanosti Hrvatske, Zagreb, 2002.
4. Solymar, L. Walsh, D. Electrical Properties of Materials, OUP, 1998.

***Recommended additional literature:***

1. Kalpakjian, S, Manufacturing Engineering and Technology, Upper Saddle River NJ, Prentice Hall, 2000.
2. R. M. Brick i dr., Structure and Properties of Engineering Materials, McGraw Hill, 1977.

***ECTS credits:*** **5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Seminar, final examination.

***Course assessment:***
Examination, tests, discussion.

## Branch: *Computer Engineering*

| SR401 | Operating Systems |
|---|---|
| ***Lecturer:*** | Goran Martinović, PhD, Assistant Professor |

***Course description:***
Overview of operating systems. Hardware requirements on operating systems, system calls. Operating system structure. Processess and threads: properties, interprocess communication, scheduling. Deadlocks: algorithms for deadlock detection and prevention. Memory management: sharing, virtual memory, paging algorithms, segmentation. Input-output devices: characteristics, disks, system clock, user interface, network communication. File system: realisation, examples. Operating system security: criptography, user authentication, attacks to the systems and protection mechanisms. Fundamentals of operating systems design: software tools, timing requirements, reliability, user interface requirements, performance evaluation. Modern operating systems through examples.

***Knowledge and skills acquired:***
Understanding of operating systems principles. Usage of modern operating systems. Overview and fundamentals of use of software tools for development of simple and efficient applications, according to operating system properties.

***Teaching methods:***

Lectures and laboratory practice are obligatory. Seminar is recommended, because it replaces part of the final examination.

***Student assessment:***
Continuous assessment of laboratory practice tasks execution and homework (occasionally).

***Obligatory literature:***

1. A.S. Tanenbaum, Modern Operating Systems (2nd Ed.), Prentice Hall, Englewood Clifs, NJ, 2001
2. L. Budin, D. Fischer, G. Martinović, Operacijski sustavi (interna skripta), 1999.
3. J.M. Hart, Windows System Programming (3rd Ed.), Addison Wesley Professional, Boston, 2004.

***Recommended additional literature:***

1. W. Stallings, Operating Systems, Pearson Education, New York, 2004.
2. S. Das, Your UNIX: The Ultimate Guide, McGraw-Hill Science, New York, 2000.
3. C. Schroder, Linux Cookbook, O'Reilly, New York, 2004.

***ECTS credits:*** **5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination. Grades earned in laboratory practice, seminar and homework can replace the written examination and/or increase the final grade.

***Course assessment:***
During and at the end of semester, students eveluate teaching successfulness by anonymous questionnaires. Lecturers who consider this course a prerequisite for their courses are also welcome to give feedback about the knowledge acquired during this course.

## Semester 5

| SA501 | Automatic Control |
|---|---|
| ***Lecturer:*** | Dražen Slišković, PhD, Assistant Professor |

***Course description:***
Controller design in time domain. Analytical controller design methods. Standard types of control loop characteristic equation. Closed loop zeroes and prefilter design. Fixed set-point control and servo control. Control loop behaviour with respect to reference variable and disturbance. Improvement of dynamic properties of control system by introducing feedforward and cascade control. Control of multivariable systems. Coupled processes and their decoupling. Practical examples. Controller implementation and antiwindup. Basic properties and structure of discrete control systems. Digital controller. Parameter-optimal digital control algorithms. Sampling time selection.

Control of processes with dead time. Basics of process identification. Introduction to sensitivity theory. Introduction to adaptive control systems. Model reference adaptive control and self-tuning controllers. Practical examples of adaptive control application.

***Knowledge and skills acquired:***
In this course students acquire knowledge of advanced methods of control loop synthesis, as well as control algorithms for some specific types of processes. Moreover, students acquire basic knowledge of digital control system properties and its implementation. Laboratory practice enables students to acquire skills in using basic software tools for control system analysis and synthesis (Matlab), and to learn about a methodology of practical implementation of control system based on the digital controller.

***Teaching methods:***

Laboratory practice tests and final examination.

***Student assessment:***
Laboratory practice tests and final examination.

***Obligatory literature:***

1. Perić, N.: Automatsko upravljanje - predavanja, Zavodska skripta, FER, Zagreb, 2004.
2. Perić, N.: Automatizacija postrojenja i procesa - predavanja, Zavodska skripta, FER, Zagreb, 2000.

***Recommended additional literature:***

1. Franklin, G.F., J.D. Powell, A.E. Naeini: Feedback Control of Dynamic Systems, Addison - Wesley Publishing Company, 1994.
2. D'Azzo, J.J., C.H. Houpis, Linear Control System - Analysis and Design - Conventional and Modern, McGraw-Hill, Inc.
3. Åström, K.J., B. Wittemark, Adaptive Control, Addison-Wesley Publishing Company, 1995.

***ECTS credits:*** **6.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
The final examination consists of the written and the oral part.

***Course assessment:***
Students' evaluation at the course end.

| **SA502** | **Electrical Machines and Electric Drives** |
|---|---|
| ***Lecturer:*** | Božidar Ivšinović, PhD, Lecturer |

***Course description:***
Classification and common characteristics. Fundamentals of mechanical energy conversion into electric energy and vice versa. Realisation of conversion. Magnetic circuit of electric machines. Machine models for DC voltages and DC current. Machine models for AC voltages and AC current. Current lining and flow. Flow of AC and polyphase excitation. Rotating magnetic field. Developed torque. Drive state. Introduction: basic principles of the electric drives, structure and system. Basic properties, general equations, drive states, characteristics of operating machines and motors, static stability. Drive mechanics: basic mechanical quantities. Reduction of mechanical quantities. Mechanical transient states. Electromechanics of drives: static characteristics, motor operation, separately and shunt-connected excited DC, synchronous and asynchronous motors. Permanent magnet synchronous motor. A general electromechanical motor model. Transient functions along the control magnitude and disturbance. Electric motor drive junction: converter-fed DC motors. Converters for AC motors.. Wide-pulse modulation. Regulated electric motor drives: cascade regulation. Optimisation of electric motor drives. Regulation of electric motor drives. Losses in transient conditions, power losses reduction. Motor choice. Drive protection. Maintaining electric motor drives: basic principles, elements and characteristics, putting in operation. Tendencies in the drive development.

***Knowledge and skills acquired:***
Knowledge of theoretical fundamentals, performances and modes of operation for electrical machines and electric drives.

***Teaching methods:***

Lectures, problem solving and laboratory practice.

***Student assessment:***
Control tests.

***Obligatory literature:***
Wolf, R.: Osnove električnih strojeva, Školska knjiga, Zagreb 1991.
Jurković, B., Elektromotorni pogoni, Školska knjiga, Zagreb, 1990.

***Recommended additional literature:***
Piotrovskij, L.M.: Električni strojevi, Tehnička knjiga, Zagreb 1970.
Gugić, P., Električni servomotori, Školska knjiga, Zagreb, 1987.
Marinović, N., Elektromotorna postrojenja, Šk.knjiga, Zagreb, 1986.

***ECTS credits:*** **6 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Test and oral examination.

***Course assessment:***
Conducting an anonymous questionnaire.

| **SAIR501** | **Microcomputers in Automation** |
|---|---|

***Lecturer:*** Dražen Slišković, PhD, Assistant Professor

***Course description:***
Signal types and system feature. Process computer and PLC. Transmitters and sensors. Data acquisition subsystem. A/D and D/A converters. Data acquisition software. Interrupt system. Output devices. Monitoring and registering process data. Software in process control. Software for processing of process data. Hardware and software approach. Measuring and control algorithms. Digital controller. System programmes. Real time operating systems. Application programmes and data bases. Visualisation and control based on processed data. Manipulation and process control. Man-machine interface. Data and state vizualisation. Data archive. Methods for control system reliability increase. Centralised and distributed system control. Computer-based control system design. Data flows. Realising and testing control system. System maintenance.

***Knowledge and skills acquired:***
Students acquire knowledge of design and application of microprocessors in automation and process control. PLC application in automation and more complex process computers are studied. Skills pertaining to microcomputer system architecture in automation, hardware and software design and real time operation are obtained. Examples of microcomputer application in automation of simple and complex processes are discussed.

***Teaching methods:***
- Lectures using multimedia presentations
- Individual learning using CD ROM
- Reading papers
- Exercises with solved problems
- Individual problem solving and team work
- Laboratory practice on ready-made models and construction of students' own simple circuits and devices

***Student assessment:***
Solving simple individual problems and team work on more complex problems.
Assessment of laboratory practice and assessment of design, construction, testing and presentation of students' own simple circuits and devices.
Written examination.
Oral examination with students for the purpose of defining the final grade.

***Obligatory literature:***
1. J.G.Bollinger, N.A.Duffie, Computer Control of Machines and Processes, Addison-Wesley, 1988.
2. P.Katz, Digital Control using Microprocessors, Prentice/Hall, 1982.
3. Perić, N.: Automatizacija postrojenja i procesa - predavanja, Zavodska skripta, FER, Zagreb, 2000.
4. Crispin, A. J.: Programmable Logic Controllers and their Engineering Applications, McGraw-Hill Publishing Company, 1997.

***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. P.S.Buckley, Techniques of Process Control, John Wiley&Sons, 1964.

***ECTS credits:*** **6.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Knowledge assessment during the semester and individual problem solving and oral examination

***Course assessment:***
Attendance on lectures, practice and examinations.

| SAR501 | Computer and Communication Networks |
|---|---|

***Lecturer:*** Drago Žagar, PhD, Associate Professor

***Course description:***
Intelligent communication network. Basics of network data transmission. Asynchronous and synchronous data transmission. Asynchronous networks and ATM. Synchronous networks. Synchronous digital hierarchy, SDH. Network function layering and layered models, OSI and TCP/IP. Physical layer and physical interface. Data link layer and flow control. Network layer and network protocols. Local area networks and protocols. Media access in LANs, MAC sublayer. Network routing and routing protocols. Internet. IPv4 and internetworking. Address space organisation in Internet, DNS system. Control protocols in Internet, ICMP protocol. Internet access. IPv6 transition process. Transport protocols in Internet, TCP and UDP. Application layer protocols, FTP, E-mail, Telnet, HTTP. Mobile networks, GSM, GPRS and UMTS. Internet access from mobile networks. Ad Hoc networks, Bluetooth. Data protection and security in network.

***Knowledge and skills acquired:***
Students will acquire knowledge necessary to use and develop computer and communication networks. By completing this course successfully students will be able to choose and design basic parameters of computer and communication networks.

***Teaching methods:***
Lectures, exercises, laboratory.

***Student assessment:***
Several tests during the semester, examination testing laboratory practice, written and oral examination.

***Obligatory literature:***
1. Bažant, et.al., Osnovne arhitekture mreža, Element Zagreb, 2003.

***Recommended additional literature:***
1. W. Stallings, Data and Computer Communications, Fourth Edition, Macmillan Publishing Company, New York, 2002.
2. A.S. Tanenbaum, Computer Networks , Fourth Edition, Prentice Hall, 2003.

***ECTS credits:*** **6 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination.

***Course assessment:***
Students' examination by the end of the course.

| SI501 | Recycling of Electrical Waste |
|---|---|

***Lecturer:*** Antun Pintarić, PhD, Associate Professor

***Course description:***
Environmental impact of engineering products and processes. Life-cycle analysis. Product End-of-Life Management. Categories of Waste Electrical and Electronic Equipment (WEEE). Waste composition. Potential uses for WEEE. Processing techniques and technologies for WEEE. Recycling targets. Disassembly and parts/material sorting. Hazardous components. Legislation (WEEE Directive). Recyclability assessment. Design for recycling.

***Knowledge and skills acquired:***
To produce a hierarchy of waste management in order of priority. To understand the interrelated nature of environmental engineering processes. To integrate basic science and engineering principles into economical solutions for WEEE problems.

***Teaching methods:***
Lectures, laboratory practice, seminar.

***Student assessment:***
Seminar paper, final examination.

***Obligatory literature:***
* * * Recycling-Handbuch: Strategie – Technologie – Produkte, Düsseldorf, VDI-Verlag 1996.

W. Koellner, W. Fichtler: Recycling von Elektro- und Elektronikschrott, Berlin, Springer-Verlag, 1996.

***Recommended additional literature:***

1. M. Šercer, D. Opsenica, G. Barić, Oporaba plastike i gume, Topgraf, Velika Gorica, 2000.
2. V. Potočnik., Obrada komunalnog otpada – svjetska iskustva, Topgraf, Velika Gorica, 1997.
3. K. Ishii, Modularity: A Key Concept in Product Life-cycle Engineering, Handbook of Life-cycle Enterprise, Kluwer, 1998.

***ECTS credits:*** **5 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Seminar paper, final examination.

***Course assessment:***

Examination, tests, discussion.

| SI502 | Computers in Power Engineering |
|---|---|

***Lecturer:*** Srete Nikolovski, PhD, Full Professor

***Course description:***

Computer applications in power engineering and network analysis. Models of power system elements. Load flow simulation. Short circuit simulation. Harmonic analysis simulation. Protective relays coordination simulation. Transient simulation. On – line power system simulation. Computer applications in modelling and projecting grounding systems of transformer stations and power plant facilities. CAD in modelling and simulation of processes in thermal power plants, hydro power plants and gas power plants. GIS systems for supervising and routing of electrical networks. Computers in systems for power system supervision, data collection and processing (SCADA systems). Computers in projecting and supervising transformer stations. Computers in projecting electrical installations and lighting.

***Knowledge and skills acquired:***

Electrical networks, facilities, installations and devices projecting using a computer. Analysis and calculation of transmission and distributive networks and low voltage installations using a computer.

***Teaching methods:***

Lectures, laboratory practice with software for power system simulation, constructions and control.

***Student assessment:***

Project.

***Obligatory literature:***

1. S. Nikolovski: Programski paketi za analizu EES, Skripta ETF Osijek
2. Upute za rad s programima ATP-EMTP, CDEGS, DIgSILENT, POWERWORLD

***Recommended additional literature:***

1. J. Arillaga, Computer analysis of power systems, John Wiley and Sons, New York, 1990.

***ECTS credits:*** **5 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Project and oral examination.

***Course assessment:***

Permanent contact with students.

| SEIA501 | Power Electronics |
|---|---|

***Lecturer:*** Ivan Flegar, PhD, Full Professor

***Course description:***

Power converters. Basic concepts. Basic properties. Conversion device concept. Constitutive devices and topology of power converters. Realisation of the following: uncontrolled switch, unilateral current, unilateral voltage and bilateral switches. DC converters. One-quadrant direct and indirect dc converters. Four -quadrant dc converters. Isolated dc converters. Rectifiers. Basic properties.Uncontrolled rectifiers. Phase-controlled rectifiers. Inverter mode of operation.Voltage-source inverter. Reduction of harmonic in output current. Resonant inverters.

***Knowledge and skills acquired:***

Acquisition of knowledge in the field of power converter technique. It is a prerequisite for comprehension of operation, testing and design of power electronic devices and equipment.

***Teaching methods:***
Lectures, problem solving and laboratory practice.

***Student assessment:***
Preliminary examination.

***Obligatory literature:***
1. I.Flegar, Power electronic circuits (In Croatian), Graphis, Zagreb, 1996.
2. D.Slišković, I.Flegar: Power electronics-Laboratory practice (In Croatian), Graphis, Zagreb,1996.

***Recommended additional literature:***
1. N.Mohan, T.M. Undeland, W.P.Robbins, Power Electronics; John Wiley &Sons Inc., New York, 1995.
2. P.T.Krein, Elements of Power Electronics, Oxford University Press, Oxford, 1998.

***ECTS credits:*** **6 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination or an examination in form of a technical report referring to design, testing and description of power electronic circuit.

***Course assessment:***
Partial examinations.

| **SE501** | **Power Switching Substations** |
|---|---|

***Lecturer:*** Zoran Kovač, MSc, Senior Lecturer

***Course description:***
Basic concepts related to power switching substations. Substation lifetime, influence on and from the environment, substation classifications. Substation structure: main (primary) and auxiliary (secondary) substation. Basic substation schemes and basic construction materials. Historical development. Strain in substations, voltage and power dimensioning, fault currents. Elements of the main substation. Conductors. Insulators. Power cables. Disconnects. Circuit breakers and switches. High-voltage fuses. Overvoltage protection. Voltage and current transformers. Power transformers. Inductors. Capacitors. Resistors. Low-voltage substations. Grounding system. Auxiliary substation subsystems. Condition, alarm and position signalisation. Measurement. Protection. Device control. Blocking. Control. Local and remote control. Telecommunications. AC and DC auxiliary voltage supply. Substation design, installation, operation and maintenance. Reliability. Regulations regarding substation installation, operation and maintenance. High-voltage, primary and secondary low voltage substations, auxiliary substations. Installation, operation and maintenance. Safety and health protection at work, first aid, fire-alarm system, environemntal protection. Quality assurance. Extensive damage in substation.

***Knowledge and skills acquired:***
Acquisition of elementary knowledge of high- and low-voltage power switching substations and their elements. Stress is put on proper use.

***Teaching methods:***
Lectures, problem solving and laboratory practice.

***Student assessment:***
Preliminary examination.

***Obligatory literature:***
1. H.Požar: Visokonaponska rasklopna postrojenja, Tehnička knjiga-Zagreb, 1990.
2. B.Belin: Uvod u teoriju električnih sklopnih aparata, Školska knjiga-Zagreb, 1978.

***Recommended additional literature:***
1. D.Keler, M.Maričević, V.Srb: Elektromonterski priručnik. Tehnička knjiga-Zagreb, 1987.
2. M.Kalea: Transformatorske stanice 35/10 kV. Elektroslavonija-Osijek, 1979.

***ECTS credits:*** **6.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination or an examination in form of a technical report referring to design, testing and description of power electronic circuit.

***Course assessment:***
Partial examinations.

| SE502 | Power Networks and Lines |
|---|---|

***Lecturer:*** Srete Nikolovski, PhD, Full Professor

***Course description:***
Electrical networks and parts of electrical networks. Purpose and progress of power systems. Types of electrical networks. Overview of power transmission theory. Line characteristic quantities. Transmission equations. Ideal transmission line. Real transmission line. Symmetrical conditions - line constants determination. Resistance. Skin effect. Inductance and capacitance. Mean geometric distances method. Line transposition. Line conductance. Corona. Equivalent schemes of power system elements for symmetrical conditions. Equivalent scheme of lines. Transformer equivalent scheme. Generator equivalent scheme. Load equivalent scheme. Four terminal in power transmission theory. General constants of elemental four terminal. Steady state calculation of electrical networks. Numerical quantities of calculation. Absolute values method. Per unit method. Overhead lines. Elements and types of lines. Conductors. Conductor mechanical calculation. Insulators. Accessories. Line towers. Grounding. Overhead line projecting. Overhead lines – operative problems. Cables. Constructive elements of cables. Cable choice criterion. Cable losses, cable warming and cooling. Low and middle voltage cables. High and very high voltage cables. Hyper-conductive and superconductive cables. Cable size choice. Cable burring, assembling and finalising.

***Knowledge and skills acquired:***
Design, construction and supervision of electrical networks, cables and overhead lines. Electrical and mechanical calculation and analysis of cables and overhead lines.

***Teaching methods:***
Lectures, numerical examples, project task: Mechanical-electrical calculation of overhead or cable line

***Student assessment:***
Project.

***Obligatory literature:***
1. Lajos Jozsa, Nadzemni vodovi, skripta ETF, Osijek, 1995.
2. V. Srb, Kabelska tehnika, priručnik, Tehnička knjiga, Zagreb, 1970.
3. M. Ožegović, K. Ožegović, Električne energetske mreže I, FESB, Split, 1996.

***Recommended additional literature:***
1. M. Ožegović, K. Ožegović, Električne energetske mreže II i III, FESB, Split, 1996.

***ECTS credits:*** **5.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Project and oral examination.

***Course assessment:***
Permanent contact with students.

| SE503 | Transformers and Electrical Rotating Machines |
|---|---|

***Lecturer:*** Milica Pužar, MSc, Senior Lecturer

***Course description:***
Transformer and its importance in the electrical system. Transformer principles, equivalent circuit and phasor diagram. Basic types and main parts. No-load, short-circuit test and loading. Losses, heating and cooling. Three-phase transformer. Connection symbols. Transformer operation conditions. Transformer testing. Electrical machines. Synchronous machine. Basic properties and types. Physical processes, parameters and equivalent circuit of synchronous machines. Synchronous machine testing basics. Induction machine. Basic properties and types. Physical processes. Equivalent circuit, circle diagram and speed-torque curve of an induction machine. Starting, reversing and braking. Speed control. Induction machine testing basics. Single-phase induction motor. DC machine. Basic properties. Physical processes in DC machines. Types and output curves of DC machines. Small electrical machines: construction, parameters and usage. Linear motors. Laboratory practice: Measurement of transformer winding resistance and no-load test. Transformer short-circuit test. Measurement of winding resistance and no-load test of a synchronous generator. Short-circuit test of a synchronous generator. Measurement of winding resistance and no-load test of an induction motor. Short-circuit test. Load curves of an induction motor. No-load curve of a DC machine. Output curve of a DC generator. Output curve of a DC motor.

***Knowledge and skills acquired:***

1. Understanding operation principles of transformers and electrical machines.
2. Knowledge of construction, types and main characteristics.
3. Acquiring knowledge necessary to be capable of working in the field of design, switching on a drive and maintenance of transformers and electrical machines.

***Teaching methods:***

Lectures by means of PowerPoint presentations, problem solving and laboratory practice with active participation of students by continuous assessment of the acquired knowledge.

***Student assessment:***

Continuous assessment during the course. Laboratory practice tests.

***Obligatory literature:***

1. R. Wolf: Osnove električnih strojeva, Školska knjiga, Zagreb, 1985.
2. A. Dolenc i drugi, Transformatori, Tehnička enciklopedija, Svezak 13, Leksikografski zavod Miroslav Krleža, Zagreb, 1997.
3. A. Dolenc, Transformatori I / II, skripta, Sveučilište u Zagrebu - Elektrotehnički fakultet, Zagreb, 1991.

***Recommended additional literature:***

1. M.Pužar, Transformatori, predavanja, Elektrotehnički fakultet Osijek, 2000.
2. M. Pužar, I.Mandić, Električni strojevi II, predavanja, Elektrotehnički fakultet Osijek, 2000.
3. D. Ban, Zbirka zadataka iz transformatora, skripta, Sveučilište u Zagrebu - Elektrotehnički fakultet, Zagreb, 1971.
4. KONČAR -grupa autora, Tehnički priručnik, KONČAR Elektroindustrija d.d., Zagreb, 1991.

***ECTS credits:*** **7 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Continuous assessment during the course, written and oral examination.

***Course assessment:***

Permanent contact with students, questionnaire.

| **SR501** | **Web Programming** |
|---|---|

***Lecturer:*** Davor Antonić, PhD, Associate Professor

***Course description:***

Internet fundamentals and development. Network addressing and naming, URL, DNS servers. Basics of network programming. 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, cascade styles, JavaScript, JavaScript and HTML, JavaScript dynamic documents, JavaApplets, XML. Server-side technologies: CGI, servlets, PHP, ASP and ASP.NET, cookies. Database access through web (PHP/SQL). Web design and application examples.

***Knowledge and skills acquired:***

Fundamentals of the Internet and advanced web programming. Design and implementation of web contents on client and server side by using new technologies.

***Teaching methods:***

Lectures and laboratory practice are obligatory whereas seminar replaces part of the final examination.

***Student assessment:***

Continuous assessment of laboratory practice execution.

***Obligatory literature:***

1. R.W. Sebesta, Programming the World Wide Web (2nd Ed.), Addison-Wesley, Boston, MA, 2004.
2. F. Halsall, Computer Networking and the Internet (5th Ed.), Addison-Wesley, Boston, MA, 2005.

***Recommended additional literature:***

1. T. Powell, Thomas, Web Design: The Complete Reference. Berkeley, CA, Osborne/McGraw-Hill, New York, NY, 2000.
2. K. Kalata, Internet Programming, Thompson Learning, London, 2001.

***ECTS credits:*** **6.5 ECTS credits**

An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***

Written and oral examination. Grades earned in laboratory practice and seminar can replace the written examination and/or increase the final grade.

***Course assessment:***
Students evaluate teaching successfulness by anonymous questionnaires.

| SR502 | Data Bases |
|---|---|

***Lecturer:*** Ninoslav Slavek, PhD, Assistant Professor

***Course description:***
Information system. DB development. Data flow. Entity relationship model. Normalisation. 1,2,3, and other normal forms. DB management system. SQL.

***Knowledge and skills acquired:***
Basic knowledge of the data bases. Basic knowledge of the system and application software.

***Teaching methods:***
Lectures are optional, laboratory practice is obligatory.

***Student assessment:***
Successful completion of laboratory practice, tests and oral examination.

***Obligatory literature:***
1. M. Varga: Baze podataka, DRIP- Zagreb, 1994.
2. D. Grundler, Primijenjeno računalstvo, Graphis, Zagreb, 2000.

***Recommended additional literature:***
1. E. Codd: The Relational model for -base Management, Addison Wesley, 1990.
2. L. Budin, Informatika za 1. razred gimnazije, Element, Zagreb, 1997.
3. J. Martin: Computer-base Organization, Prentice Hall, 1977.

***ECTS credits:*** **6.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination.

***Course assessment:***
At the end of the semester an official questionnaire can be conducted in which students will evaluate of the course lectures and lecturers participating in the course teaching

| SR503 | Object-oriented Programming |
|---|---|

***Lecturer:*** Davor Antonić, PhD, Associate Professor

***Course description:***
Basic principles of object-oriented programming, differences to procedural programming. C++ programming language. Class and object. Variables and functions as part of an object. Class elements, access control. Basic methods of objects creation and destruction. Life span of an object. Polymorphism, list of different objects, virtual functions. Inheritance. Class access control: private, protected and public. Operator overloading. Function and class templates. Exception handling. Basic features of the Java programming languages, differences to C++.

***Knowledge and skills acquired:***
Object-oriented approach to software development. Detail knowledge of C++ programming language.

***Teaching methods:***
Lectures, laboratory practice.

***Student assessment:***
Laboratory practice evaluation, tests.

***Obligatory literature:***
1. Motik, Šribar, Demistificirani C++ (2. izd.), Element, Zagreb, 2003.

***Recommended additional literature:***
1. B. Stroustrup: The C++ Programming Language, Addison-Wesley, Reading, 1986.
2. S. Lippman: C++ Primer 2ed, Addison-Wesley, Reading, 1994.

3. The Java Tutorial (http://java.sun.com/)

***ECTS credits:*** **6.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination.

***Course assessment:***
Students' questionnaire.

## Semester 6

| SAIR601 | Automation Technique |
|---|---|

***Lecturer:*** Dražen Slišković, PhD, Assistant Professor

***Course description:***
Production system and industrial plant. Tasks of production system control and their stratification. Informatisation and automation of production systems. Basic structure of process automation system. Practical examples. System for acquisition and representation of process values. Automatic process control system. Digital implementation of controller. Process computer and programmable logic controller (PLC). Connecting process computer to the process. Operate unit – central unit in the process automation system. Operate unit structures: central and decentral, hierarchical and distributed. Supervisory unit – subsystem for operator-production system interface, including the process database. Structures of supervisory unit. Automation components for building of operate and supervisory unit. Communication systems in industry. General purpose information transfer technologies/standards typically used as basis of some industrial communication standards. Communication technologies at the process level. PLC networks. Software and programming tools in automation systems. Examples of complete control and supervision systems in automated production. Design and maintenance of automation systems.

***Knowledge and skills acquired:***
This course introduces students to the tasks of the production control and building of automation system. Laboratory practice enables students to gain knowledge of PLC programming and methodology of practical control system implementation.

***Teaching methods:***
Lectures and laboratory practice.

***Student assessment:***
Laboratory practice tests and final examination.

***Obligatory literature:***
1. Crispin, A. J.: Programmable Logic Controllers and their Engineering Applications, McGraw-Hill Publishing Company, 1997.

***Recommended additional literature:***
1. Jović, F.: Kompjutersko vođenje procesa, Zveza organizacij za tehničko kulturo Slovenije, Ljubljana, 1988.
2. Perić, N.: Automatizacija postrojenja i procesa - predavanja, Zavodska skripta, FER, Zagreb, 2000.
3. Smiljanić, G.: Računala i procesi, Školska knjiga, Zagreb, 1991.

***ECTS credits:*** **5.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
The final examination consists of the written and the oral part.

***Course assessment:***
Students' evaluation at the course end.

| SAIE601 | Process Measurements, Sensors and Actuators |
|---|---|

***Lecturer:*** Dražen Dorić, MSc, Senior Lecturer

***Course description:***
Measurement of process values: distance, position, angle, angular velocity, force, torque, level, pressure, flow, temperature, pH value and other process values. Signal transfer technologies. Disturbances and their sources. Measurement error. Signal processing. Sensors in control systems. Actuators: DC, AC and step motors, pneumatic,

electropneumatic, hydraulic and electrohydraulic devices, pumps, compressors and valves. Thyristor converters and transistor converters. Static and dynamic characteristics of sensors and actuators. Intelligent sensors. Input-output units and interfaces in sensors and actuators.

***Knowledge and skills acquired:***
Knowledge of principles, properties and methods of application of sensors and actuators used in automatic control. Knowledge needed for integration of sensors and actuators in control systems.

***Teaching methods:***

Lectures and laboratory practice.

***Student assessment:***
Laboratory practice tests and final examination.

***Obligatory literature:***

1. Kovačić, Z., S. Bogdan, Elementi automatizacije procesa - predavanja, Zavodska skripta, Zavod za APR, FER, Zagreb
2. Fraden, J., Handbook of Modern Sensors - Physics, Designs and Applications, Second edition, AIP Press, NY, 1997.

***Recommended additional literature:***

1. Šantić, A., Elektronička instrumentacija, Školska knjiga, Zagreb, 1988.,
2. Tomac, J., Osnove automatske regulacije - predavanja, Fakultetska skripta, ETF, Osijek, 2004.
3. Šurina, T., Analiza i sinteza servomehanizama i procesne regulacije, Školska knjiga, Zagreb, 1974.

***ECTS credits:*** **5.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Seminar paper and oral examination.

***Course assessment:***
Questionnaire.

| **SIA601** | **Introduction to Robotics and Intelligent Control** |
|---|---|

***Lecturer:*** Robert Cupec, PhD, Assistant Professor

***Course description:***
Introduction to robotics: basic terms, classification and examples of robots. Description of position and orientation of rigid body. Transformation between coordinate systems. Direct and inverse kinematics of robot manipulator. Dynamic model of robot manipulator. Position and force control of robot manipulator. Sensors used in robotics. Basics of robot vision. Flexible production systems. Basics of fuzzy set theory. Fuzzy logic control. Structures of fuzzy logic controllers. Basic structures of neural networks. Static and dynamic neural networks. Learning algorithms. Neural networks in modelling, identification and control of systems. Genetic algorithms.

***Knowledge and skills acquired:***
Knowledge needed for creating kinematic and dynamic model of the robot manipulator based on its mechanical specifications and application of these models for manipulator control. Knowledge of sensors used in robotics and basic principles of robot vision. Basics of flexible production systems. Basics of intelligent control.

***Teaching methods:***

Lectures and laboratory practice.

***Student assessment:***
Laboratory practice tests, seminar paper and final examination.

***Obligatory literature:***

1. Z. Kovačić, S. Bogdan, V. Krajči, Osnove robotike, Graphis Zagreb, 2002.
2. C. T. Lin, C. S. G. Lee, Neural Fuzzy Systems - A Neuro-Fuzzy Synergism to Intelligent Systems, Prentice Hall, 1996.

***Recommended additional literature:***

1. J. J. Craig, Introduction to Robotics: Mechanics and Control, Addison

***ECTS credits:*** **5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Seminar paper and oral examination.

***Course assessment:***
Questionnaire conducted among students.

| SIAE601 | Electric Power Substations Control |
|---|---|

***Lecturer:*** Pavle Filko, PhD, Senior Lecturer

***Course description:***
Fundamental physical laws for electrical power system operation. Balance between electric power generation and electric power consumption. Basic requirements for operation of electrical power system. Active power- and voltage regulation of electrical power plant by own network operation. Mutual dependence between load, exciter and lead voltage on synchronous machine. Primary and secondary turbine regulation. Relationship between several electric power plants and electrical power system. Electric power plant estimation on the basis of economy. Load economical division between thermal power plant units. Classical systems of synchronous machine exciter. Fast regulation. Power transformers Voltage regulation. On-load tap changer. Longitudinal and transversal voltage network regulation. Voltage regulation by means of static capacitors. Coordination of voltage regulation in electric power plant and electric network. Electric energy and electrical power demand in an electrical power system. Load curve and load curve duration. Electric energy-power curve. Analysis of covering demand for electric energy and electrical power in electrical power systems with various electrical power plant structure. Constant and variable energy method.

***Knowledge and skills acquired:***
Acquisition of elementary knowledge necessary for control and regulation in electric power substations and electrical power system.

***Teaching methods:***
Lectures, problem solving and laboratory practice.

***Student assessment:***
Continuous assessment during the course. Testing laboratory practice tasks.

***Obligatory literature:***
1. L. Jože: Osnove regulacije u EES, ETF Osijek, 1992.
2. M. i K. Ožegović: Električne mreže II, Skripta ETF Split, 1997.

***Recommended additional literature:***

***ECTS credits:*** **5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Oral examination.

***Course assessment:***
Questionnaire, discussions and contact with students.

| SRIA601 | Digital Communication Systems |
|---|---|

***Lecturer:*** Slavko Rupčić, MSc, Senior Lecturer

***Course description:***
Introduction to digital communication systems. Transmission of the digital signal in base band and high frequency bands. Amplitude Shift Keying (ASK & M-ary ASK). Frequency Shift Keying (FSK, CPFSK & M-ary FSK). Phase Shift Keying (PSK, MSK & M-ary PSK). Evaluation of modulation scheme. Complex modulation schemes. Pulse signal modulation: amplitude (PAM), duration (PDM), position (PPM) and frequency (PFM). Digital modulations: pulse-code modulation (PCM) and delta modulation (DM). Modulation of orthogonal signals (Walsh signal, wavelet signal). Time division multiple access systems - TDMA and frequency division multiple access systems - FDMA. Source coding. Channel coding. Block coding. Complex coding schemes. Modulator and demodulator devices. Basic types of communication channels. Carrier recovery. Timing recovery: phase recovery, clock recovery, edge detection. Noise in digital communication systems. Filtering of digital signals. Detection of signals in the presence of noise. Optimum receiver for linearly modulated signal with additive white gaussian noise.

***Knowledge and skills acquired:***
Students will learn about digital communication systems and analyse different typs of digital communication systems.

***Teaching methods:***

Lectures, problem solving, laboratory practice.

***Student assessment:***
Experimental work examination. Oral and written examination.

***Obligatory literature:***
1. Modlic, B.Modlic: Visokofrekvencijska elektronika - Modulacija, modulatori, sintezatori frekvencije, Školska knjiga, Zagreb 1982.
2. J.G.Proakis, Digital Communications, 4th ed., McGraw Hill, N.Y., 2000.

***Recommended additional literature:***
1. G.Lukatela, Digitalne telekomunikacije, Građevinska knjiga, Beograd, 1988.
2. J.G.Proakis, Digital Communications, 4th ed., McGraw Hill, N.Y., 2000.

***ECTS credits:*** **5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination.

***Course assessment:***
Students' questionnaires.

| SE601 | Electric Drives |
|---|---|

***Lecturer:*** Zdravko Valter, PhD, Full Professor

***Course description:***
Tasks, structure and kinds of electric drives. Basic properties and driver states. Static stability. Driver mechanic and reduction of mechanical dimensions. Mechanical transients. Static characteristics of working and breaking for DC motors and three-phase asynchronous and synchronous motors. Synchronous motors with permanent excitation. General electromechanical model of an electrical motor. Variable voltage supply for DC motors. Regulated electric drives. Cascade regulation. Energy flow and optimisation of an electric drive. Choice of a driver motor. Protection and maintenance of drives. Trends of development.

***Knowledge and skills acquired:***
Students will become familiar with drive kinds, their properties and characteristics. They will also develop capability for calculation and choice of a drive system for concrete application.

***Teaching methods:***
Lectures,calculations and laboratory practice.

***Student assessment:***
Laboratory reports.

***Obligatory literature:***
1. Jurković, B., Elektromotorni pogoni, Školska knjiga, Zagreb, 1990.

***Recommended additional literature:***
1. Grupa autora, Elektromotorni pogoni, TE/4 JLZ, Zagreb, 1973.
2. Marinović, N., Elektromotorna postrojenja, Šk.knjiga, Zagreb, 1986.
3. Gugić, P., Električni servomotori, Školska knjiga, Zagreb, 1987.

***ECTS credits:*** **5.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination.

***Course assessment:***
Students' questionnaire.

| SE602 | Power Plants and Power System |
|---|---|

***Lecturer:*** Damir Šljivac, PhD, Assistant Professor

***Course description:***
Basic features of power plants. Hydro power plants. Thermal power plants. Nuclear power plants. Alternative energy sources. Electrical schemes of power plants. Voltage stability of power network. Voltage control. Short circuit in the power network. Physical basics of short circuits. Treatment of the power network neutral. Short circuit current

calculations. Short circuit current reduction. Line to ground failure. Protection, localisation and elimination of line to ground failure. Power transmission stability. Static stability. Transient stability. Basic physical rules of the power system operation. Power plant active power and voltage control by operating on the own network. Power plant active power and frequency control by parallel operation with the system.

***Knowledge and skills acquired:***
Basic knowledge of power plants and the power system.

***Teaching methods:***
Students are obliged to attend both lectures and exercises.

***Student assessment:***
Two control tests during the semester.

***Obligatory literature:***
1. M. i K. Ožegović, Električne energetske mreže IV, FESB Split, 1999.
2. L. Jozsa: Kratki spoj – dijelovi predavanja, interna skripta, Elektrotehnički fakultet Osijek, 2002.
3. L. Jozsa: Osnove regulacije u elektroenergetskom sistemu, skripta, Elektrotehnički fakultet Osijek, 1994.
4. S. Nikolovski, Elektroenergetske mreže – zbirka riješenih zadataka, Elektrotehnički fakultet Osijek, 1998.

***Recommended additional literature:***
1. Elgred, D. Electric Energy Systems Theory, Mc-Graw Hill, N.Y., 1983.
2. H. Požar, Visokonaponska rasklopna postrojenja, Tehnička knjiga Zagreb, 1990.
3. B. Stefanini, Prijenos električne energije II dio - mreže, Skripta FER Zagreb, 1971.

***ECTS credits:*** **5.5 ECTS credits**
ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination.

***Course assessment:***
Students' questionnaire.

| **SIE601** | **Power System Protection** |
|---|---|

***Lecturer:*** Damir Karavidović, BSc, Lecturer

***Course description:***
This course covers the following topics: basic terms referring to electrical power system (EPS) and its inside events; faults and failures; basic requirements for protective systems; elements of EPS protective systems; criteria for protection acting; current value, current differential, current direction criteria, active power and reactive power criteria; impedance, voltage and criteria of frequency change; non-electrical criteria for protection acting (temperature, gas, light arch); transmission line protection; LV, MV and HV lines protection; lines protection in star and radial network; MV lines protection in different neutral point earthing ways; protection and telemetry in MV networks; automatic reclosure; synchro check, transformer protection; transformer characteristics in protection point of view; protection of transformers with small, medium and large power; Bucholz protection; bus-bar protection; bus-bar protection with spare protection of another EPS element; proprietary bus-bar protection (for example differential protection); protection of other EPS elements; chokes protection; electric machines protection; EPS frequency breakdown protection; overvoltage protection; integrated functions of protection and control systems; terminal fields; testing and startup; necessary activities, testing equipment, procedures; maintenance activities; EPS plant event analyses through protection acting.

***Knowledge and skills acquired:***

***Teaching methods:***
Students are obliged to attend both lectures and laboratory practice.

***Student assessment:***
Preliminary, written and oral examination.

***Obligatory literature:***
1. S. Nikolovski: Osnove relejne zaštite u EES, Interna skripta, ETF Osijek, 2001.

***Recommended additional literature:***
1. F. Božuta: Automatski zaštitni uređaji u elektroenergetskom sistemu, Svijetlost, l Sarajevo, 1987.
2. H. Požar: Visokonaponska rasklopna postrojenja, Tehnička knjiga, Zagreb, 1990.

***ECTS credits:*** **5 ECTS credits**

ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination.

***Course assessment:***
At the end of semester an official questionnaire can be conducted referring to students' evaluation of the course teaching and lecturers participating in course teaching.

| SIE602 | Transmission and Distribution of Electrical Energy |
|---|---|

***Lecturer:*** Branko Štefić, BSc, Lecturer, Željko Novinc, PhD, Senior Lecturer

***Course description:***
Power transmission. Power transmission network types. AC and DC power transmission. Components of power transmission systems. Equivalent schemes of power transmission lines. Conditions on ideal transmission line. Travelling waves on long transmission lines. Conditions on real transmission line. Exact equivalent schemes of transmission lines. Transformer and generator in power transmission system. Electrical networks calculation. Voltage regulation. Stability. Power and energy losses. Economic problems. Short circuit conditions. Short circuit protection. Transmission and distributive network grounding. Power distribution. Distribution networks topology. Types of distributive networks. Voltage drop on distributive grid element. Calculation of single supplied, double supplied and complex networks with ring structure. Distributed and lumped load. Complex networks with ring structure. Load flow, short circuit and reliability calculation. Grounding types and touch voltage safety requirements in low voltage networks. Cable and overhead line networks. Networks planning, load growth, location of new transformer stations in network. Voltage regulation in distributive networks, reactive power compensation, availability and reliability of distributive networks. Cable distribution systems. Distribution systems in rural areas. Distribution system protection. Overvoltages in distributive systems.

***Knowledge and skills acquired:***
Calculation and analysis of distribution and transmission networks. Design, construction and supervision of distribution and transmission networks.

***Teaching methods:***
Lectures, problem solving, laboratory practice using software for transmission and distribution network analysis.

***Student assessment:***
Seminar paper.

***Obligatory literature:***
1. M.i K. Ožegović: Električne mreže I, II, III & IV, skripta ETF Split, 1996.
2. B. Štefić, S.Nikolovski: Prijenos i distribucija električne energije, Skripta, ETF Osijek 2001.
3. S. Nikolovski: Elektroenergetske mreže – zbirka riješenih zadataka, ETF Osijek, 1998.

***Recommended additional literature:***
1. Bergen, Vitall, Power system analysis, Prentice Hall, 2000.

***ECTS credits:*** **5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Project and oral examination.

***Course assessment:***
Permanent contact with students.

| SR601 | Multimedia Technique |
|---|---|

***Lecturer:*** Snježana Rimac-Drlje, PhD, Associate Professor

***Course description:***
Introduction: definitions, types of media, area of applications. Multimedia data types: text, graphics, images, video, animations. Audio: sampling, real-time processing, filtering, coding. Image: bitmap and vector graphics, color presentation, image processing. Video: video standards and coding of the color information, digital video file formats. Components of a multimedia system - hardware and software. Hypermedia, interactive documents. Preparation of a multimedia content for CD-ROM and WWW. Broadband and intelligent networks: aspects of creation, implementation, management and realisation of the multimedia communications services. Communication protocols for multimedia, quality of services. Laboratory practice: file formats and still image compression; digitalisation and audio signal compression; design of a web site with multimedia contents; preparation of a

CD/DVD with multimedia contents.

***Knowledge and skills acquired:***
Students will be introduced to characteristics of still images, speech, audio signal and video signal. They will acquire knowledge of multimedia systems and parameters which influence quality of the multimedia transmission. Students will work on programmes for preparation of multimedia contents for web and CD/DVD.

***Teaching methods:***

Lectures (3 hours per week), laboratory practice (1 hour), design exercises (1 hour)

***Student assessment:***
Testing of laboratory practice tasks, written and oral examination.

***Obligatory literature:***

1. S. Rimac-Drlje: Multimedijska tehnika – predavanja, zavodska skripta, Eleketrotehnički fakultet, Osijek, 2003.
2. S. Rimac-Drlje: Multimedijska tehnika – upute za laboratorijske vježbe, zavodska skripta, Eleketrotehnički fakultet, Osijek, 2003.

***Recommended additional literature:***

1. K. R. Rao, Multimedia Communication Systems: Techniques, Standards and Networks, Prentice Hall PTR, 2002.
2. N. Chapman, J. Chapman, Digital multimedia, John Wiley & Sons, Chichester, 2000.

***ECTS credits:*** **5.5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Project, written and oral examination.

***Course assessment:***
Students' evaluation.

| SIR601 | **Software Design and Programming** |
|---|---|

***Lecturer:*** Ninoslav Slavek, PhD, Assistant Professor

***Course description:***
Software design and programming goals. Functional decomposition, structure diagrams, activity diagrams, decision tree and decision tables. Data base design, automatisation of the system analysis, design and coding. Projects overview, software system testing strategy. Software standards. Human-computer interface. Output information release. Design documentation. Software system engineering. Software life cycle. Overall operation of hardware, operating system and applications. Traditional and object-oriented paradigm. Programming and remote control on the net.

***Knowledge and skills acquired:***
Basic knowledge of the computer hardware. Basic knowledge of the system and application software. Basic knowledge of programming.

***Teaching methods:***

Lectures are not obligatory, laboratory practice is obligatory.

***Student assessment:***
Successful completion of laboratory practice, tests and oral examination.

***Obligatory literature:***

1. D. Grundler, Primijenjeno računalstvo, Graphis, Zagreb, 2000.
2. R. Pressman: Software engineering, McGraw-Hill N.Y., 1995 Addison Wesley, Menlo Prk, Cal., 1994.
3. W. Humphrey: Managing the Software Process, Addison-Wesley 1990.
4. B. Motik, J. Šribar, Demistificirani C++, Element, Zagreb, 1997.

***Recommended additional literature:***

1. L. Budin, Informatika za 1. razred gimnazije, Element, Zagreb, 1997.
2. D. Patterson, J. Hennessy, Computer Organization and Design: The Hardware / Software Interface (2nd Edition), Morgan Kaufmann Publ., San Francisco, 1997.

***ECTS credits:*** **5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination.

***Course assessment:***
During and at the end of the semester a course evaluation questionnaire will be conducted.

| SIR602 | Coding and Information Protection |
|---|---|

***Lecturer:*** Drago Žagar PhD, Associate Professor

***Course description:***
Basic information properties. Information sources. Redundancy. Source information coding, block and optimal codes. Communication channel properties. Noise in channel. Transmission errors information protection. Signal encoder and decoder. Single parity and product codes. Hamming codes. Cyclic codes. Convolutional codes. BCH codes. Codes efficiency. Error detection and correction by computers: processors, RAMs, ROMs, CD ROMs, magnetic media and mass storage. Problems of protecting the information against unauthorised access. Basics of cryptography. DES. AES. RSA. Public and private keys.

***Knowledge and skills acquired:***
Students will gain necessary knowledge to protect information against errors and unauthorised information access in communications and computing.

***Teaching methods:***
Lectures, problem solving, laboratory practice.

***Student assessment:***
Several tests during the semester, laboratory practice tasks testing, written and oral examination.

***Obligatory literature:***
1. N. Rožić, Informacija i komunikacije, Kodiranje s primjenama, Alineja , Zagreb 1992.
2. V. Sinković, Informacija, simbolika i semantika, Školska knjiga Zagreb, 1997.
3. E. Šehović i dr., Uvod u integrirane digitalne sisteme, FER, Zagreb, 1991.

***Recommended additional literature:***
1. S. Gravano, Introduction to Error Control Codes, Oxford University Press, Oxford, 2001.
2. M. Purser, Introduction to Error-Correcting Codes, Artech House, Boston-London, 1995.

***ECTS credits:*** **5 ECTS credits**
An ECTS credit value has been added according to calculation of time required for studying and successful course completion.

***Examination methods:***
Written and oral examination.

***Course assessment:***
Students' examination by the end of the course.