



University of Rijeka  
Faculty of Engineering



**CURRICULUM  
UNDERGRADUATE UNIVERSITY STUDY OF  
ELECTRICAL ENGINEERING**

Rijeka, June 2005

## CONTENTS

1. INTRODUCTION	2
2. GENERAL PART	5
2.1. The title of the study	5
2.2. Holder and performer of the study	5
2.3. Duration of study	5
2.4. Enrolment conditions	5
2.5. Competence, qualifications and continuation of study	5
2.6. Academic title	6
3. CURRICULUM DESCRIPTION	7
3.1. List of obligatory and elective subjects with the number of lectures active hours needed for their performing and ECTS credits	7
3.2. Subjects description	9

## 1. INTRODUCTION

The year 1857, when the Imperial-Royal Naval Academy was relocated from Trieste to Rijeka, marks the beginning of a systematic education of engineering personnel in the Rijeka region. It enabled the establishment of the full time four-year study with courses in the fields of iron ship construction and steam engines for the needs of the Austrian navy. It lasted until 1918, i.e. to the end of the 1st World War.

The foundation of the *Faculty of Mechanical Engineering in Rijeka* in 1960 for the requirements of the industry of Rijeka and wider region can be regarded as the continuation of systematic education and scientific research work in the field of the engineering sciences, particularly for mechanical engineering and naval architecture. At the beginning, only the education of graduate engineers of Mechanical Engineering was offered, but since 1969/70 the graduate engineers of Naval Architecture were also educated. The Faculty was renamed into *Mechanical-Naval Architecture Faculty in Rijeka*. The opening of the study for graduate Civil Engineers in 1971/72 brought about the establishment of the independent *Faculty of Civil Engineering* and the renaming of our Faculty into the *Technical Faculty Rijeka*. Finally, since 1994 the Faculty has been functioning under the name *University of Rijeka, Faculty of Engineering*. In 1999/2000 the education of graduate engineers in Electrical Engineering commenced.

In the academic year 1965/66 the Faculty organized the education for earning higher vocational degree. This study of Mechanical Engineering and Naval Architecture was held not only in Rijeka but also for some generations of students in Labin and Pula, especially for the employees of the shipyard *Uljanik*. In the period from 1964 - 1974 the Faculty collaborated with the *Maritime Academy in Pula* to educate qualified personnel for the navy. In 1987 the vocational study of Electrical Engineering was established to satisfy the needs for specialists of higher vocational degree in the field of electrical engineering.

In 1971/72 the post graduate scientific study was inaugurated to enable graduate engineers of Mechanical Engineering and Naval Architecture to widen their acquired knowledge and scientific permanent education.

The Faculty collaborates with related European Institutions of Higher Education as follows: the Faculty of Mechanical Engineering and Naval Architecture in Zagreb, the Faculty of Electrical Engineering and Computing in Zagreb, the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture in Split, etc. in the country, as well as with Technische Universität Wien, Austria, Facoltà di Ingegneria, Università degli Studi di Trieste and Università degli Studi di Udine, respectively, Italy, Fakulteta za strojništvo in Ljubljana and Maribor, respectively, Slovenia, Vysoké učení technické v Brně, Czech Republic, Technische Universiteit Delft, the Netherlands, Universität Stuttgart, Germany, Faculty of Engineering, University Heriot-Watt, Edinburgh, Scotland etc. abroad.

Since the Faculty foundation, a very intensive collaboration with industry and electric-power industry has been realized especially with managers directly interested in the transferring of experiences from theory into practice and in the modernizing of

curricula. Good examples are: shipyards *3. maj* and *Uljanik*, the factory and foundry *CIMOS* in Buzet and Roč, INA, HEP, etc.

This short historical overview shows that the Faculty of Engineering in Rijeka has been based on solid tradition of industry and education in Rijeka and its region, on the economy of the Republic of Croatia and on experiences deriving from collaboration with renowned institutions of Higher Education in the Republic of Croatia and Europe.

Today, the Faculty of Engineering numbers 62 permanent employees in scientific-teaching, teaching and associate vocations, 40 junior researchers, 55 associate lecturers and assistants, and 47 administrative employees and technical personnel. The Faculty scientists carried out a lot of scientific research projects financed by the state, as well as development projects for the needs of the economy. Some of the scientists have received town, national and international awards for their work.

As the only higher education institution for the education of graduate engineers, masters and doctors of engineering sciences in the area of Northern Adriatic County of Croatia (Primorsko-goranska, Istarska and Ličko-senjska), the Faculty mostly complies with the requirements of this area for highly-educated personnel from the fields of mechanical engineering and naval architecture and partly from electrical engineering, in metal-working industry, shipbuilding and energetic, especially in energetic of tourist facilities, as well as in some other activities, from design to insurance companies and on local government level. The following figures testify to this fact: 2092 graduate engineers of Mechanical Engineering, 266 graduate naval architects, 16 graduate engineers of Electrical Engineering, 630 mechanical engineers, 79 naval engineers, 542 electrical engineers, 83 Masters of Science and 64 Doctors of Science in the field of engineering sciences.

From its inception up to the present, the curricula and programs have, several times, been updated and streamlined, always with the aim of keeping abreast of the real needs of the regional economy. A logical outcome of streamlining the curriculum in Mechanical Engineering, Naval Architecture, Electrical Engineering and related engineering fields was to supplement certain courses and to introduce new subjects in the wake of scientific achievements in the fields of Mechanical Engineering and Naval Architecture and related engineering fields. Therefore, scientific disciplines linked to the application of computers and CAD, numerical methods, electronics, ecology, non-conventional treatment processes, elastomechanics and plastomechanics, processing of polymers, utilization of renewable energy sources, technology management, tribology, quality management, flexible and intelligent systems, computer aided process planning and control, metal protection, CIM & CAE systems, integral shipbuilding technology, automation, mechatronics and robotics are studied.

With coming into force of the new Law on Scientific Activity and Higher Education in August 2003 a statutory provision was made to adjust study programs to the Bologna Declaration using the common credit point system evaluation. The proposals of study programs at the Faculty of Engineering, University of Rijeka, completely comply with these requirements as they foresee the undergraduate 6 semester both the university and vocational study. After completing these studies, both the academic and vocational degree *baccalaureus* is earned as well as the knowledge and skills necessary for professional tasks with slight orientation. The undergraduate university

study is followed by 4 semester graduate university study which confers the *Master's degree* and all the necessary education for the most complicated engineering tasks based on scientific approach to problem solving. The postgraduate scientific study at the Faculty of Engineering, University in Rijeka, lasts for 6 semesters and logically follows a graduate university study. Students of other fields with corresponding previous knowledge can be also enrolled. After completing this study the *Doctor's degree in Engineering Sciences* is earned.

The model for these study programs has been the program of similar studies of the European Higher Institutions, having in view the achievement of specific regional needs for which the specialists at the Faculty of Engineering, University of Rijeka are educated. Parts of the suggested study programs and subject groups of particular studies are in accordance with duration, number of lectures, curricula and flexibility in compliance with respectable European Higher Institutions such as: Technische Universität Graz and Vienna, respectively, Austria, Vysoké učení technické v Brně, Czech Republic, University College London, England, IUT Cergy-Pontoise and Institute Supérieur de Gestion Industrielle, Lille, France, Facoltà di Ingegneria, Università degli Studi di Trieste, Italy, Technische Universiteit Delft, the Netherlands, Technische Universität Berlin and Clausthal, respectively, and Hochschule Bremen Fachbereich Elektrotechnik und Informatik and Universität Stuttgart, respectively, Germany, Fakulteta za strojništvo, Ljubljana, Slovenia, Faculty of Engineering, Universities of Glasgow and Strathclyde, Scotland, etc. The Bologna Declaration recommendations relating to the quality assurance of the study programs, the mobility during the study and acknowledgements of diplomas are also incorporated in these programs.

The Faculty of Engineering, University of Rijeka is a traditionally very well established Higher Education Institution which completely satisfies all the criteria regarding the upgrading and improvement of the existing studies to the respectable West European level.

## **2. GENERAL PART**

### **2.1. The title of the study**

- *Undergraduate University Study of Electrical Engineering*

### **2.2. Holder and performer of the study**

- *University of Rijeka, Faculty of Engineering*

### **2.3. Duration of study**

- *3 -year study*

### **2.4. Enrolment conditions**

The undergraduate university study of Electrical Engineering can be enrolled after attaining secondary school qualification in the four year period and passing the entrance exam in accordance with conditions for enrolment published in the press by the University of Rijeka. The number of enrolment places is limited by quotas regulated by the Ministry of Education, Science and Sport. During the classification enrolment procedure, general secondary school achievement including secondary school diploma or final exam and the marks in mathematics and physics are evaluated. The Faculty Council of the Faculty of Engineering regulates special enrolment conditions for every academic year as well as privileges for the best candidates.

### **2.5. Competence, qualifications and continuation of study**

After completing of undergraduate university study of Electrical Engineering, the student must possess fundamental knowledge in mathematics, physics, electrical engineering and computer application. Furthermore, the student should know how to prepare and perform an experiment or specific measurements, and how to deal with and interpret the results. The student should be capable of identifying, formulating and solving the problem. He must be good at using the modern engineering devices and at solving the wider spectrum of engineering tasks. He must be given the opportunity to specialize in a certain field. The student should be able to work in a multidisciplinary group to understand the importance of efficient communication when solving a specific engineering problem. During his work he must respect both professional and ethical canons and the environmental protection. The graduate student of this study must be

capable of getting involved into permanent education and professional development and possess comprehensive education (knowledge of non-engineering topics).

If the student decides to continue his education, he can enrol for graduate study of Electrical Engineering at the Faculty of Engineering, University of Rijeka, or the same study at any other university in the Republic of Croatia.

## **2.6. Academic title**

- *baccalaureus of Electrical Engineering*

### 3. CURRICULUM DESCRIPTION

#### 3.1. List of obligatory and elective subjects with the number of lectures active hours needed for their performing and ECTS credits

1. semester				
Subject Title	hours / week			ECTS
	L	E	L + E	
Mathematics I	3	3	6	7
Physics I	2	2	4	5
Fundamentals of Electrical Engineering I	3	3	6	7
Introduction to Computing	2	3	5	6
Engineering Graphic and Documenting	2	2	4	4
<b>TOTAL</b>	<b>25<sup>(1)</sup></b>			<b>30<sup>(1)</sup></b>
Physical and Health Education <sup>(1)</sup>	0	2	2	1

L - lesson, E - exercise

<sup>(1)</sup>not included in hours/week total, but contributes with 1 ECTS credit

2. semester				
Subject Title	hours / week			ECTS
	L	E	L + E	
Mathematics II	3	3	6	7
Physics II	2	2	4	5
Fundamentals of Electrical Engineering II	3	3	6	7
Programming	2	3	5	6
Mechanic and Construction Elements	3	1	4	4
<b>TOTAL</b>	<b>25<sup>(1)</sup></b>			<b>30<sup>(1)</sup></b>
Physical and Health Education <sup>(1)</sup>	0	2	2	1

<sup>(1)</sup>not included in hours/week total, but contributes with 1 ECTS credit

3. semester				
Subject Title	hours / week			ECTS
	L	E	L + E	
Mathematics for Engineers ET	2	2	4	5
Electrical Measurements	3	3	6	7
Electronics I	2	2	4	5
Electrical Circuits	3	1	4	5
Thermodynamics and Energy	3	1	4	5
Foreign Language I <sup>(2)</sup>	1	2	3	3
<b>TOTAL</b>	<b>25</b>			<b>30</b>

<sup>(2)</sup>elective: English or German - free choice

Undergraduate University Study of Electrical Engineering

4. semester				
Subject Title	hours / week			ECTS
	L	E	L + E	
Digital Electronics	3	3	6	7
Electronics II	2	2	4	5
Basic of Automatic Control	3	2	5	7
Technology of Material	2	1	3	3
Foreign Language II <sup>(2)</sup>	1	2	3	3
Industrial Practice I <sup>(3)</sup>				5
<b>TOTAL</b>			<b>21</b>	<b>30</b>

<sup>(2)</sup>elective: English or German - free choice (continuation from 3rd sem.)

<sup>(3)</sup>contributes with 5 ECTS credits

5. semester				
Subject Title	hours / week			ECTS
	L	E	L + E	
Electrical Machines	3	3	6	7
Power Electronics	3	3	6	7
Elective Project <sup>(4)</sup>	0 (1)	4 (3)	4	5
<b>Subjects from elective group Electroenergetics (EE) of conjugated subjects:</b>				
Electric Power Substations	3	2	5	6
Basic of Constructing	3	1	4	5
<b>Subjects from elective group Automatics (A) of conjugated subjects:</b>				
Elements of Plant Automation	3	2	5	6
System Modelling and Simulation	2	2	4	5
<b>TOTAL</b>			<b>25</b>	<b>30</b>

<sup>(4)</sup>election from list of offered projects

**List of offered projects:**

Basic of Automatic Control, Electrical Machines, Power Electronics, Electric Power Substations, Elements of Plant Automation

Undergraduate University Study of Electrical Engineering

<b>6. semester</b>				
<b>Subject Title</b>	<b>hours / week</b>			<b>ECTS</b>
	<b>L</b>	<b>E</b>	<b>L + E</b>	
Electrical Drives	2	2	4	5
Alarm Systems	2	3	5	5
Organization and Economics of Enterprises	2	1	3	3
Final Work <sup>(5)</sup>				8
<b>Subjects from elective group Electroenergetics (EE) of conjugated subjects:</b>				
Electrical Power Networks	3	2	5	6
Free Elective Subject <sup>(6)</sup>	2	1	3	3
<b>Subjects from elective group Automatics (A) of conjugated subjects:</b>				
Automatic Control	3	2	5	6
Free Elective Subject <sup>(6)</sup>	2	1	3	3
<b>TOTAL</b>			<b>20</b>	<b>30</b>

<sup>(5)</sup>contributes with 8 ECTS credits

<sup>(6)</sup>election from list of offered subjects or some other subject at free choice in worth of 3 ECTS credits or more

**List of offered free elective subjects:**

Any subject from undergraduate university studies of Mechanical Engineering and Naval Architecture in 6. semester

<b>UNDERGRADUATE UNIVERSITY STUDY OF ELECTRICAL ENGINEERING TOTAL</b>	<b>141</b>	<b>180</b>
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**Notes:**

- in 6th semester tuition can be performed in blocks if needed

### 3.2. Subjects description

Description of each subject is given in the following in the alphabetical order.

## **ALARM SYSTEMS**

### **Draft of subject contents**

Introduction to safety & security systems concept. Difference between safety and security concepts. A historical overview of safety and security systems.

Fire protection systems - fire alarm and fire extinguishing systems. Evacuation systems.

Anti-intrusion and anti-robbery systems. Remote reporting solutions. Central reporting stations.

Video-surveillance systems. Classic, hybrid and digital systems. Typical architectures. Special applications video-surveillance equipment. Access control systems for people and vehicles. Methods of identification. Difference between identification and authentication. Biometrics.

Mobile systems. Tracking systems and mobile reporting systems. Fleet management systems.

Special purpose systems. Systems of automatic and expert traffic surveillance. Perimeter protection.

Integrated systems. Real-time telemetric systems. Asset management systems.

### **Developing of general and specific competences (knowledge and skills)**

Acquiring knowledge about safety & security systems through lectures attendance and literature studying. Acquiring specific skills in S&S systems design, implementation and programming through practical exercises and individual and group work on practical assignments.

### **Forms of tuition performing and manner of knowledge checking**

Lectures, oral and practical exercises. Group work on practical assignments. Periodical tests and final practical and written task.

### **List of literature needed for studies and sitting for an examination**

Neil Cumming, "Security: A Guide to Security System Design and Equipment Selection and Installation", Butterworth-Heinemann 1992; Vlado Damjanovski, "CCTV", Butterworth-Heinemann 2000; Joel Konicek, Karen Little, " Security, ID Systems and Locks : The Book on Electronic Access Control", Butterworth-Heinemann 1997

### **List of literature that is recommended as supplemental**

group of authors, "Vodič za projektiranje sustava vatrodjave", Alarm automatika internal edition, Rijeka 2002; Marko Kričančić, Davor Delišimunović, "Zaštita i sigurnost financijskih institucija", Tectus, Zagreb, 2001

### **ECTS credits attributed to subject and corresponding explanation**

5 ECTS. Lectures 1 cr. (25 hours), oral exercises 1 cr. (25 hours), practical exercises 1 cr. (25 hours). Literature studying 1 cr. (20 hours). Final practical assignment 1 cr. (20 hours).

### **Manner of sitting for an examination**

3 periodical tests and final assignment. Tests performance values for 60% and final ass.t for 40%

### **Manner of quality inspection and efficiency of subject performing**

Through students success statistics analysis and anonymous questionnaires. Through quest.s, the lecturers quality and effort, lectures organization quality and evaluation objectivity shall be valued.

### **Prerequisites for subject enrolling**

Electronics II.

## **AUTOMATIC CONTROL**

### **Draft of subject contents**

Terms and definitions. Basic control structures and characteristics. Analysis of linear control systems in time and frequency domain. Stability. PID regulator and other regulators developed from the PID regulator. Time and frequency domain conventional and modern control system design. Graph-analytical and analytical methods, cascade control - technical and symmetrical optimum, design in the state space. State estimators. Basics of process identification. Basics of sensitivity theory.

### **Developing of general and specific competences (knowledge and skills)**

The aim of the subject is adopting of theoretical knowledge form the automation field.

### **Forms of tuition performing and manner of knowledge checking**

Lecturing with knowledge checking based on partial exams. Laboratory exercises with home works and oral examinations. Exercises with problems solving.

### **List of literature needed for studies and sitting for an examination**

N. Perić: Automatsko upravljanje, Skripta Zavoda za APR, FER, Zagreb, 1998.

G.F.Franklin, J.D. Powell, A.E.Maeini: Feedback Control of Dynamic Systems, Addison-Wesley, Reading, 1986.

### **List of literature that is recommended as supplemental**

Lj. Kuljača, Z. Vukić: Automatsko upravljanje sistemima, Školska knjiga, Zagreb, 1985.

### **ECTS credits attributed to subject and corresponding explanation**

6 ECTS. Lecturing and exercises - total 75 hours (3 credits); Time for learning and studying - 60 hours (2 credits); Time for making home works and preparations for exercises - 30 hours (1 credit).

### **Manner of sitting for an examination**

Partial exams, home works and oral examination form subject final mark.

### **Manner of quality inspection and efficiency of subject performing**

Anonymous poll in the end of semester. Statistical reports on results obtained on partial exams and laboratory exercises. In the end statistical report on passing.

### **Prerequisites for subject enrolling**

Fundamentals of Automatic Control.

## **DIGITAL ELECTRONICS**

### **Draft of subject contents**

Digital data representation. Codes. Basic logic circuits and their electronic implementation. Boolean algebra. Combinational logic circuits. Minimization methods. Digital integrated circuits. Standard combinational modules. Combinational circuits implementation with standard modules. Bistable circuits, Registers and counters. Design of sequential circuits. Moore and Mealy algorithmic state machines. A/D and D/A conversion. Arithmetic circuits. Memories.

### **Developing of general and specific competences (knowledge and skills)**

Understanding basic concepts and theory of logic circuits. Ability of using fundamental analysis and design methods of combinational and sequential circuits and systems. Understanding characteristics of modern electronic implementation of such systems.

### **Forms of tuition performing and manner of knowledge checking**

Lectures. Exercises lessons for exam preparations. Laboratory exercises with goal to get acquainted with modern electronic implementations of digital circuits and systems.

### **List of literature needed for studies and sitting for an examination**

U. Peruško: Digitalna elektronika, Školska knjiga, 1996.

U. Peruško, V. Glavinić: Digitalni sustavi, Školska knjiga, Zagreb, 2005. (u pripremi-na recenziji).

### **List of literature that is recommended as supplemental**

M. Mano: Digital Design, Prentice Hall, 1991.

S. Brown, Z. Vranesic: Fundamentals of Digital Design with VHDL Design, McGraw Hill, Boston, 2000.

### **ECTS credits attributed to subject and corresponding explanation**

7 ECTS. Lecturing and exercises - total 90 hours (3 credits). Time for learning and studying - 90 hours (3 credits). Homeworks - 30 hours (1 credit).

### **Manner of sitting for an examination**

Partial exams, laboratory work, homeworks and final project form student's final mark.

### **Manner of quality inspection and efficiency of subject performing**

Reports on results obtained on quizzes, partial exams, laboratory, homeworks, and final results. Anonymous poll in the end of semester.

### **Prerequisites for subject enrolling**

Fundamentals of Electrical Engineering II, Electronics I.

## **ELECTRIC POWER NETWORKS**

### **Draft of subject contents**

Definition and basic structure of electric power networks. Types and division of EP networks. EP networks development through history. EP networks elements. Construction and technology of overhead electric lines. EP networks' electric parameters calculation - resistance, inductance and capacitance of networks' elements. Network's elements equivalent circuits. Electric power transmission theory basics and calculation. Equivalent circuit composition. Fourpoles. EP network analysis by matrix calculation. Matrix formation. EP network calculation approach. Load flow in general. Voltage and load flow calculation. EP network's neutral point earthing. Short circuit analysis and calculation. EP network stability. Stability calculation. Medium and low voltage EP networks calculation. EP transmission networks problems. Distribution networks problems. Electric energy consumption development planning. EP networks development planning.

### **Developing of general and specific competences (knowledge and skills)**

Physical understanding of relationships between electrical parameters in EP networks, under different operations conditions. Ability for modelling, calculating and determining the electric conditions in EP networks. Ability to solve the given problems, in order to analyze or optimally develop EP networks.

### **Forms of tuition performing and manner of knowledge checking**

Lecturing, throughout which knowledge is checked in tests and partial exams. Auditory and construction exercises for lecture examinations, autonomous realization of construction projects, and final project completion.

### **List of literature needed for studies and sitting for an examination**

M. Ožegović, K. Ožegović: Electric power networks, FESB Split, Computing Split, 1996.-2002.

M. Ožegović, K. Ožegović: Electric networks, FESB Split, 1977.-1982.

S. Nikolovski, D. Šljivac: Electric power networks - exercise book, ETF Osijek

### **List of literature that is recommended as supplemental**

Stag G.W.; El-Abiad A.H. : Computer Methods in Power System Analysis, McGraw-Hill, New York, 1968.

Venikov V.A.: Electrical Network Performance Calculations and Analysis, Mir Publishers, Moscow, 1985.

### **ECTS credits attributed to subject and corresponding explanation**

6 ECTS. Lecturing - total 45 hours and exercises - 30 hours (2 credits). Time for learning and literature research 90 hours (2 credits); Time for construction projects and final project 90 hours (2 credits).

### **Manner of sitting for an examination**

Tests, partial exams, construction projects and final project determine the final mark.

### **Manner of quality inspection and efficiency of subject performing**

Anonymous poll at the semester end. Regular statistical reports on tests, partial exams and construction projects passing scores. Final passing score statistics.

### **Prerequisites for subject enrolling**

Electrical Networks, Electric Power Plants.

## **ELECTRIC POWER SUBSTATIONS**

### **Draft of subject contents**

Structure and characteristics of HV and LV electric power substations in industry and power systems. Substation's description and performance. Methods and calculation procedures for substation's and plant's equipment sizing. Voltage and current stress. Peak current, breaking current and short time withstand current. Substation's elements dimensioning and configuration definition in relation to voltage level and role in the power system. Symmetrical and unsymmetrical triphase systems. Power systems' elements sequence impedances. Substation's auxiliary equipment for: control, measurement, signalization and protection. Busbars, bushings, and supporting insulators sizing. Phenomena during current interruption; circuit breaker types and sizing. Disconnectors and HV fusegear. Instrument transformers. Surge arresters. Substation protective and operational earthing. Operational measurement in substations. Power sources and elements of secondary power supply distribution.

### **Developing of general and specific competences (knowledge and skills)**

The subject is the basic professional discipline for all electrical engineering students of Electric power systems orientation. Its purpose is to give an introduction to substations and equipment for power production, transmission and distribution in industry and power systems.

### **Forms of tuition performing and manner of knowledge checking**

Lecturing, throughout which knowledge is checked in tests and partial exams. Auditory and construction exercises for lecture examinations, autonomous realization of construction projects, and final project completion.

### **List of literature needed for studies and sitting for an examination**

H. Požar: High voltage switchgear, Tehnička knjiga, Zagreb, 1990.  
H. Požar: Electric substations, Školska knjiga, Zagreb, 1990.  
B. Belin: Introduction to switching apparatus theory, Školska knjiga, Zagreb, 1978.

### **List of literature that is recommended as supplemental**

K. Begović: Hydroenergy plants  
H. Požar: Electric energy production, script, Faculty of electrical engineering and computing, Zagreb.

### **ECTS credits attributed to subject and corresponding explanation**

6 ECTS. Lecturing - total 45 hours and exercises - 30 hours (2 credits). Time for learning and literature research 90 hours (2 credits); Time for construction projects and final project 90 hours (2 credits).

### **Manner of sitting for an examination**

Tests, partial exams, construction projects and final project determine the final mark.

### **Manner of quality inspection and efficiency of subject performing**

Anonymous poll at the semester end. Regular statistical reports on tests, partial exams and construction projects passing scores. Final passing score statistics.

### **Prerequisites for subject enrolling**

No prerequisites.

## **ELECTRICAL CIRCUITS**

### **Draft of subject contents**

Definition and principal laws of electrical circuits. Elements of circuits. Kirchhoff's laws. Circuits equations at time domain and frequency domain. Free and forced circuit response. Circuits theorems. Circuit functions and it's properties. First and second order circuits. Synthesis of one-ports. Foster's and Cauer's realization. Equations and parameters of two-port and multi-port circuits. Mirror parameters. Characteristics and connections of two-ports. Electrical filters. Circuits with distributed parameters. Ideal line and special cases of lines.

### **Developing of general and specific competences (knowledge and skills)**

Understanding of relationship between electrical parameters in electrical circuits. Ability of solving circuits and behaviour determination of electrical circuits. Ability of solving given problem to determinate state in electrical circuits.

### **Forms of tuition performing and manner of knowledge checking**

Lecturing with knowledge checking based on quizzes, partial exams and homeworks. Exercises with problems solving and preparing for final project.

### **List of literature needed for studies and sitting for an examination**

N. Stojković, V. Naglić, N. Mijat: Theory of networks and lines, Tehnički fakultet, Rijeka, 2005.  
N. Stojković: Theory of networks and lines - problems collection, Tehnički fakultet, Rijeka, 2005.

### **List of literature that is recommended as supplemental**

N. Stojković, N. Mijat: Analog signal processing, Tehnički fakultet, Rijeka, 2005.  
Ivanšić, I.: Function of complex variable and Laplace transformation, Sveučilišna naklada Liber, Zagreb, 1978.

### **ECTS credits attributed to subject and corresponding explanation**

5 ECTS. Lecturing and exercises - total 60 hours (2 credits); Time for learning and studying 60 hours (2 credits); Time for making homeworks and final project 30 hours (1 credit).

### **Manner of sitting for an examination**

Quizzes, partial exams, homeworks and final project form subject final mark.

### **Manner of quality inspection and efficiency of subject performing**

Anonimus poll in the end of semester. Statistical reports on results obtained on quizzes, partial exams, homeworks and final project. In the end statistical report on passing.

### **Prerequisites for subject enrolling**

Mathematic II, Fundamentals of Electrical Engineering II.

## **ELECTRICAL DRIVES**

### **Draft of subject contents**

Basic mechanical concept of rotational machines and loads. Commutator machines with serial, parallel and separate excitation as part of electrical drives. Control of a separately excited DC machine. Universal machines in electrical drives. Induction machines: the structure. Static characteristics, classical open-loop control. Scalar open- and close-loop control of induction motors using a v/f method. Frequency controllers and methods for generation of variable frequency and magnitude voltages. Application of power electronics in electrical drives: choppers, converters, PWM and SVM. Synchronous machines as motors and generators, characteristics, application and problems.

### **Developing of general and specific competences (knowledge and skills)**

Understanding the demands of electrical drives. Particularities of single machines in electrical drives. Universal criteria for the evaluation of suitability: cost of purchase and maintenance, the complexity of application and control of the machine and accompanying devices (for control and supply).

### **Forms of tuition performing and manner of knowledge checking**

Lectures. Exercises oriented towards investigations of practical examples of application of electrical drives, supporting the lectures.

### **List of literature needed for studies and sitting for an examination**

B. Jurković: "Elektromotorni pogoni", Školska knjiga, Zagreb, 1986.

M. E. El-Hawary: "Principles of Electric Machines with Power Electronic Applications", Prentice -Hall, Inc., 1986. (2002.)

### **List of literature that is recommended as supplemental**

W. Leonhard: „Control of Electrical Drives“, Springer Verlag, 1996

V. Ambrožič: „Sodobne regulacije pogonov z izmeničnimi motorji“, Fakulteta za elektrotehniko, Ljubljana, 1996

### **ECTS credits attributed to subject and corresponding explanation**

5 ECTS. Lecturing and exercises - total 60 hours (2 credits); Learning and studying the references 60 hours (2 credits); Final report on exercises 30 hours (1 credit).

### **Manner of sitting for an examination**

Oral and written exams.

### **Manner of quality inspection and efficiency of subject performing**

Anonymous poll at the end of semester. Statistical reports on exams' efficiency. Electric drives market and technology demands analysis.

### **Prerequisites for subject enrolling**

Electrical Machines.

## **ELECTRICAL MACHINES**

### **Draft of subject contents**

1. Magnetic Systems
2. Transformers
3. Energy Conversion
4. Basic Principles of Electrical Machines
5. Synchronous Machines
6. Space Vektors
7. Sinusoidal Permanent Magnet AC Drives
8. Asynchronous machines - sinusoidal steady state
9. DC and ECM Drives

### **Developing of general and specific competences (knowledge and skills)**

Understand the basic principles of operations and control of Electrical machines and transformers, and be able to predict their steadystate performance from mathematical models and equivalent circuits. Have gained experimental competence through laboratory experiments.

### **Forms of tuition performing and manner of knowledge checking**

Teaching methods: lectures, lecture-based problem classes, computer-assisted simulation examples, laboratory sessions.

Knowledge checking: Two midterm examinations, laboratory report and final examination.

### **List of literature needed for studies and sitting for an examination**

R.Wolf: *Osnove električnih strojeva*, Školska knjiga, Zagreb, 1991.

N. Mohan: *Electric Drives*, MNPERE, 2003.

### **List of literature that is recommended as supplemental**

G.R.Slemon: *Electric Machines and drives*: Addison -Wesley , 1992.

### **ECTS credits attributed to subject and corresponding explanation**

7 ECTS. Course Work Sessions: 30% lecture-based problem classes, 35% computer-assisted simulation problems, 35% experimental. Upon finished simulation problems short reports are requested. Testing reports are requested upon finished each experimental labs sessions.

### **Manner of sitting for an examination**

3 short laboratory report 15 %, Each midterm exam 15 %, Final examination 55%.

### **Manner of quality inspection and efficiency of subject performing**

Discussion with student during lectures and course work sessions.

### **Prerequisites for subject enrolling**

Fundamentals of Electrical Engineering II.

## **ELECTRICAL MEASUREMENTS**

### **Draft of subject contents**

The international system of units. Measurement uncertainty. Measurement elements. Measurement sources. Electromechanical measurement instruments. Electrical and electronic energy meters. Measurement transformers. Measurement of electrical quantities. Magnetic measurements. Isolation testing. Point of cable failure determination. Measurements of non-electrical quantities. Transducers and sensors of non-electrical quantities. Function generators. Signal generators. Impulse generators. Electronic instruments. Measurement amplifiers and attenuators. Analog electronic measurement instruments. Oscilloscopes. Oscilloscope's measurements. Digital electronic measurement instruments. Communication instrument-computer.

### **Developing of general and specific competences (knowledge and skills)**

Introduction to measurements basics, characteristics of electrical and electronic measurement instruments and measurement methods. Ability of performing measurements and the knowledge for application of optimal measurement techniques.

### **Forms of tuition performing and manner of knowledge checking**

Lecturing with knowledge checking based on partial exams. Laboratory exercises with homeworks and oral examinations. Exercises with problems solving.

### **List of literature needed for studies and sitting for an examination**

Bego, V.: *Electrical measurements*, Graphis, Zagreb, 2003.

Vujević, D.: *Electrical measurements, Laboratory exercises*, University of Zagreb, Zagreb, 1993.

### **List of literature that is recommended as supplemental**

Schrufner, E.: *Elektrische Messtechnik*, Hanser, Munchen, 1988.

### **ECTS credits attributed to subject and corresponding explanation**

7 ECTS. Lecturing - total 45 hours (3 credits); Exercises - 60 hours (2 credits); Time for learning, studying and making homeworks - 30 hours (2 credits).

### **Manner of sitting for an examination**

Partial exams, homeworks and oral examination form subject final mark.

### **Manner of quality inspection and efficiency of subject performing**

Anonimus poll in the end of semester. Statistical reports on results obtained on partial exams and laboratory exercises. In the end statistical report on passing.

### **Prerequisites for subject enrolling**

Fundamentals of Electrical Engineering II.

## **ELECTRONIC I**

### **Draft of subject contents**

Introduction and examination of development of electronics. Examination of basic characteristic and appearances of semiconductor materials. Mechanisms of leading the currents in semiconductors. Planar technology on silicon. Creation of pn junction. Theory of pn junction. Semiconductor pn diodes. Metal-semiconductor junction and metal-semiconductor diodes. Heterojunctions. Optoelectronic elements based on pn junction. Bipolar transistors-static and dynamic characteristics. Schottky transistor. Real bipolar transistors. Thyristors and unipolar transistors. Unipolar junction transistor with field effect. MOS structure and its characteristics. Unipolar MOS transistors. Other semiconductor elements.

### **Developing of general and specific competences (knowledge and skills)**

Becoming acquainted with tribute-work principles of semiconductor electronic elements. Developing the abilities for their usage.

### **Forms of tuition performing and manner of knowledge checking**

Tuition is performed through lectures, auditorial and laboratory practice. Knowledge checking is done through the control tasks and the verbal exam.

### **List of literature needed for studies and sitting for an examination**

P.Biljanović: *Poluvodički elektronički elementi*, Školska knjiga, Zagreb, 2004

P.Biljanović, D.Grgec, T.Suligoj: *Zbirka zadataka iz elektroničkih elemenata*, FER, Zagreb, 2004.

### **List of literature that is recommended as supplemental**

J.Singh: *Semiconductor Devices*, Mc Graw- Hill, 2000.

### **ECTS credits attributed to subject and corresponding explanation**

5 ECTS points. Lectures and practices- each 60 hours (2 points). The necessary time for learning and studying of literature-60 hours (2 points). The necessary time for making seminar-30 hours (1 point).

### **Manner of sitting for an examination**

The control tasks and the partial verbal exam. Written and verbal exam is also possible.

### **Manner of quality inspection and efficiency of subject performing**

Conversation and polls with students throughout the semester. Statistics about efficiency on control tasks, written and verbal examinations.

### **Prerequisites for subject enrolling**

Mathematics II, Fundamentals of electrical engineering II.

## **ELECTRONIC II**

### **Draft of subject contents**

The basic ideas about amplifiers. The influence of nonlinear characteristics of components on tribute-work of electronic structures. Basic amplifier structures with bipolar transistor. Basic amplifier structures with unipolar transistor. Cascade amplifying structures. Frequency characteristics of electronic structures. Noise theory. Structures with recurrent relation. Frequency characteristics and stability of structures with negative recurrent relation. Differential amplifier. Power amplifiers. Sinusoidal oscillator. Linear and nonlinear forming of wave forms. Bipolar, MOS and CMOS switch. Comparator. Bistabile multivibrator. Monostabile multivibrator. Astabile multivibrator. Saw voltage and current generators.

### **Developing of general and specific competences (knowledge and skills)**

Becoming acquainted with tribute-work principles of semiconductor electronic elements. Developing the abilities for their usage.

### **Forms of tuition performing and manner of knowledge checking**

Tuition is performed through lectures, auditorial and laboratory practice. Knowledge checking is done through the control tasks and the verbal exam.

### **List of literature needed for studies and sitting for an examination**

P.Biljanović: Elektronički sklopovi, Školska knjiga, Zagreb, 2003.

I.Zulim, P.Biljanović: Elektronički sklopovi - Zbirka zadataka, Školska knjiga, Zagreb, 1995.

### **List of literature that is recommended as supplemental**

G.G.Glasford: Analog Electronic Circuits, Prentice-Hall, 2000.

### **ECTS credits attributed to subject and corresponding explanation**

5 ECTS points. Lectures and practices- each 60 hours (2 points). The necessary time for learning and studying of literature-60 hours (2 points). The necessary time for making seminar-30 hours (1 point).

### **Manner of sitting for an examination**

The control tasks and the partial verbal exam. Written and verbal exam is also possible.

### **Manner of quality inspection and efficiency of subject performing**

Conversation and polls with students throughtout the semester. Statistics about efficiency on control tasks, written and verbal examinations.

### **Prerequisites for subject enrolling**

Electronics I.

## **ELEMENTS OF PLANT AUTOMATION**

### **Draft of subject contents**

Control system structure. Elements of automated systems. Control objects; actuators; power amplifiers; measuring devices; control devices. Elements for protection, supervision and visualization of states in automated systems. Principles and mathematical description of physical phenomena in control system elements. Static and dynamic characteristics. Transfer functions and frequency characteristics. State space description. Experimental methods for parameter determination.

### **Developing of general and specific competences (knowledge and skills)**

Knowledge about principles and types of elements of plant automation. Understanding of automated system and connections among elements. Ability to determine parameters of static and dynamic characteristics of plant automation elements. Work with real elements.

### **Forms of tuition performing and manner of knowledge checking**

Lectures and laboratory exercises with knowledge checking based on partial exams and regular examinations during laboratory exercises.

### **List of literature needed for studies and sitting for an examination**

Z. Kovacic (2003): Elements of plant automation - Lecture notes. Zavod za APR, FER Zagreb (in Croatian).

Z. Ban (2002): Elements of plant automation - Lecture notes. Zavod za APR, FER Zagreb (in Croatian).

### **List of literature that is recommended as supplemental**

M.H. Rashid (1988): Power Electronics: Circuits, Devices and Applications, Prentice Hall, Englewood Cliffs, New Jersey.

T. Surina (1974): Analiza i sinteza servomehanizama i procesne regulacije, Skolska knjiga, Zagreb.

### **ECTS credits attributed to subject and corresponding explanation**

6 ECTS:

Lecturing and exercises - total 75 hours (2,5 credits);

Time for learning and studying 75 hours (2,5 credits);

Time for preparation for laboratory exercises and making reports 30 hours (1 credit).

### **Manner of sitting for an examination**

Partial exams and regular laboratory work examinations form a final grade.

### **Manner of quality inspection and efficiency of subject performing**

Anonymous poll at the end of the semester. Updated reports on the results achieved (partial exams and laboratory examinations). Final statistical report on passing.

### **Prerequisites for subject enrolling**

Mathematics II, Physics II.

## **ENGINEERING GRAPHICS AND DOCUMENTING**

### **Draft of subject contents**

The significance and possibilities of graphical communications. The design process and the role of the design model. Traditional, 2D and 3D CAD techniques for the development of documentation. The shape description. Standardization and standards. Technical documentation graphics. Drawn and textual electro technical documentation.

### **Developing of general and specific competences (knowledge and skills)**

The development of the ability to produce and communicate technical documentation in standard drafting formats, by use of traditional and computer techniques.

### **Forms of tuition performing and manner of knowledge checking**

The tuition comprises lectures with computer demonstration, practical work by means of traditional tools and practical work using computer and commercial software. The assessment is continual through the collections of practical works and oral presentation, and based on final examination.

### **List of literature needed for studies and sitting for an examination**

M. Opalić, M. Kljajin, S. Sebastijanović: *Tehničko crtanje*, Sveučilište u Zagrebu, Sveučilište J.J. Strossmayer u Osijeku, Čakovec 2003.

L. Padovan: *Inženjerska grafika i dokumentiranje*, Sveučilište u Zagrebu, Zagreb 1999.  
*Inženjerski priručnik-IP1*, Školska knjiga, Zagreb, 1996.

### **List of literature that is recommended as supplemental**

F. E. Giesecke i dr. : *Technical Drawing*, Prentice Hall, New Jersey 2002.

G. Scott Oween et al. : Hypergraph (on -line), ACM SIGGRAPH Education Committee, <http://www.education.siggraph.org>

### **ECTS credits attributed to subject and corresponding explanation**

4 ECTS. 100% constructive practical work: the accomplishment of collections of graphical works by means of traditional tools and by computer. The preparatory work for different examination forms (written and oral). Supporting study of the recommended material (Internet, books, magazines). Continual consultations related to actual work.

### **Manner of sitting for an examination**

Written and oral examination.

### **Manner of quality inspection and efficiency of subject performing**

Continual efficiency analysis of the subject matter adoption and final examination results, anonymous students` feedback and the attending to the area recent requirements.

### **Prerequisites for subject enrolling**

No prerequisites.

## **ENGLISH I**

### **Draft of subject contents**

Improving general English. Introduction into language of specific purposes in the fields of Electrical Engineering from the following fields: Engineering Fundamentals of Electrical Engineering. Conductors and Insulators. Materials in Electrical Engineering. Electromagnetism. Basic Notions of Energy and Electromotive Force. Characteristics of Capacitance. Lenz` s Law, Ohm` s Law. Electric Units. Grammar and language structures. Verb tenses. Definite and indefinite article. Comparison of adjectives. Relative sentences. Introduction into abstract writing. Writing of Curriculum and business letters. Analysis of technical articles and general English texts.

### **Developing of general and specific competences (knowledge and skills)**

Students improve their knowledge of English and their language competence so as to communicate and express themselves in everyday language as well as those required for specific purposes in order to adapt to contemporary world of technology.

### **Forms of tuition performing and manner of knowledge checking**

Lectures deal with the topics of general English and English for specific purposes. Language practice (tutorials) is focused on language structures, reading and listening comprehension, translation and developing writing and communication skills. Tests, written and oral exam.

### **List of literature needed for studies and sitting for an examination**

Bartolić, Lj.: Technical English in Electronics and Electrical Power Engineering, Šk. Knjiga, Zagreb, 1987.

Vince, M.: Intermediate Language Practice, Heinemann ELT, Oxford, 1998.

### **List of literature that is recommended as supplemental**

Selected professional articles and texts at upper intermediate level (Cambridge Univ. Press and Longman).

### **ECTS credits attributed to subject and corresponding explanation**

3 ECTS. Written and oral exam 35%, active participation during tuition 35%, literature and paper preparation and power-point presentation 30%.

### **Manner of sitting for an examination**

Written and oral exam.

### **Manner of quality inspection and efficiency of subject performing**

Speaking and writing skills, team work and presentation of set topics, review tests

### **Prerequisites for subject enrolling**

No prerequisites.

## **ENGLISH II**

### **Draft of subject contents**

Improving general English. Introduction into language of specific purposes in the fields of Electrical Engineering from the following fields: Information Theory. Introduction to Electric Power Systems. Switches, Circuit Breakers, Fuses. Conduction and Transmission of Electric Current. Transformers. Electric Generators and Motors. Characteristics of Electrical Machines. Measuring Instruments. Grammar and language structures. Passive. Sequence of Tenses. Reported Speech. Modal Verbs. Compounds. Word formation. If-Clauses. Writing of abstracts and business letters. Analysis of technical articles and general English texts.

### **Developing of general and specific competences (knowledge and skills)**

Students improve their knowledge of English and English for specific purposes. They become competent in analyzing authentic materials and write abstracts.

### **Forms of tuition performing and manner of knowledge checking**

Lectures deal with the topics of general English and English for specific purposes. Language practice (tutorials) is focused on language structures, reading and listening comprehension, translation and developing writing and communication skills. Tests, written and oral exam.

### **List of literature needed for studies and sitting for an examination**

Bartolić, Lj.: Technical English in Electronics and Electrical Power Engineering, Šk. Knjiga, Zagreb, 1987.

Murphy R.: English Grammar in Use. Cambridge University Press, 1994

### **List of literature that is recommended as supplemental**

Selected professional articles and texts at upper intermediate and advanced level (Cambridge Univ. Press and Longman)

### **ECTS credits attributed to subject and corresponding explanation**

3 ECTS. Written and oral exam 35%, active participation during tuition 35%, literature and paper preparation and power-point presentation 30%

### **Manner of sitting for an examination**

Written and oral exam

### **Manner of quality inspection and efficiency of subject performing**

Speaking and writing skills, team work and presentation of set topics, review tests

### **Prerequisites for subject enrolling**

No prerequisites.

## **FINAL WORK**

### **Draft of subject contents**

The content of Final Work is based on the use of acquainted knowledge during whole undergraduate university study (especially of professional subjects). The content is given by the Commission for Final Students' Works. Chosen mentor looks after student's work on a given concrete professional task.

### **Developing of general and specific competences (knowledge and skills)**

Stand alone ability of solving the concrete professional task.

### **Forms of tuition performing and manner of knowledge checking**

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### **List of literature needed for studies and sitting for an examination**

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### **List of literature that is recommended as supplemental**

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### **ECTS credits attributed to subject and corresponding explanation**

8 ECTS. The task content of Final Work is given in frame of 200 hours of stand alone student's work.

### **Manner of sitting for an examination**

Evaluation of written Final Work and, especially, oral defend in front of Commission.

### **Manner of quality inspection and efficiency of subject performing**

-

### **Prerequisites for ortal defend**

All exams must be done.

## **FUNDAMENTALS OF AUTOMATIC CONTROL**

### **Draft of subject contents**

Introduction about automatic control. Open loop and closed loop control systems. Differential equation and Laplace transform in mathematical description of components of closed loop control system. Static and dynamic characteristics. Transfer function of passive electric networks. Time responses and transient characteristics of linear time invariant systems. Frequency characteristics of linear time invariant systems. Stability analysis of control systems - algebraic (Routh and Hurwitz) and frequency (Nyquist and Bode) methods. Relative stability indices. Regulation and servo problem. Accuracy of servo control systems. Topology (structure) of conventional regulators (PID). Mathematical model of linear time invariant systems by state variables.

### **Developing of general and specific competences (knowledge and skills)**

Understanding of dynamic system components. Capability to analyze control systems (stability, accuracy) and determine conventional regulator characteristics. Problem solving capability in order to synthesize linear continuous time invariant control systems.

### **Forms of tuition performing and manner of knowledge checking**

Lectures. The knowledge will be evaluated by tests and home works.

Auditory and laboratory work will be obligatory for students and this will help them to better prepare for exams and final papers.

### **List of literature needed for studies and sitting for an examination**

Matika, D. and Brnobić, D. (2004): Basics of automatic control, Mimeographed notes, Technical Faculty Rijeka, Croatia

Vukić, Z. and Kuljača, Lj. (2004): Automatic Control - analysis of linear systems. Zagreb; Kigen, d.o.o.

Nise, N.(2000): Control System Engineering. New York; John Wiley and Sons.

### **List of literature that is recommended as supplemental**

Kuljača, Lj. and Vukić, Z. (1985): Automatic control of systems. Zagreb; Croatia, Školska knjiga.

Šurina, T.(2001): Automatic regulation. Zagreb; Croatia, Školska knjiga.

### **ECTS credits attributed to subject and corresponding explanation**

7 ECTS. Lectures and exercises - 75 hours (3 credits). Time necessary for learning and literature studies 75 hours (3 credits); Time required for preparation of laboratory exercises and final paper 30 hours (1 credits).

### **Manner of sitting for an examination**

Quizzes, partial exams, home works and final project form subject final mark.

### **Manner of quality inspection and efficiency of subject performing**

Anonymous poll at the end of the semester. Statistical reports on results obtained on quizzes, partial exams, home works and final project. At the end statistical report on passing.

### **Prerequisites for subject enrolling**

Mathematics II, Fundamentals of electrical engineering II.

## **FUNDAMENTALS OF DESIGN**

### **Draft of subject contents**

Types of load. Stresses and deformations of machine elements. Material characteristics. Allowable stresses. Stress concentration. Thermal stresses.

Types of machine elements. Welded joints. Bonded joints. Riveted joints. Bent sheet metal joints. Snap joints. Threaded fasteners. Power screws. Pins. Shaft-hub connections. Springs. Axes and shafts, critical speed.

Lubricants, friction, lubrication. Rolling bearings. Sliding bearings. Bearings lubrication. Sealing of bearings, axes and shafts.

Mechanical transmissions. Gears. Spur gears. Belts. Chains.

Clutches and couplings.

### **Developing of general and specific competences (knowledge and skills)**

General knowledge about types, functions, materials and calculation of machine elements.

### **Forms of tuition performing and manner of knowledge checking**

Lectures and training. Supervising project during training.

### **List of literature needed for studies and sitting for an examination**

Križan, B., *Osnove proračuna i oblikovanja konstrukcijskih elemenata*, Sveučilište u Rijeci, 1999.

Krautov strojarski priručnik, Axiom, Zagreb, 1997.

### **List of literature that is recommended as supplemental**

Decker, K.-H., *Elementi strojeva*, Tehnička knjiga, Zagreb, 1987.

### **ECTS credits attributed to subject and corresponding explanation**

5 ECTS. 150 pages of text to be learned. Accomplishment of a design project.

### **Manner of sitting for an examination**

Oral exam.

### **Manner of quality inspection and efficiency of subject performing**

Anonymous questionnaires at the end of the semester. Control of results achieved during semester.

Analysis of exams efficiency.

### **Prerequisites for subject enrolling**

Previously attended courses in engineering graphics and mechanics.

## **FUNDAMENTALS OF ELECTRICAL ENGINEERING I**

### **Draft of subject contents**

Electrical charge. Coulomb's law. Electrical field. Electrical influence. Electrical flux density vector. Gauss' law. Electrostatic field's work of force. Electrical potential and voltage. Electrostatic lines of force and equipotential surfaces. Electrical field and potential correlation. Capacitor i capacity of capacitor. Substance in field. El. field on border between dielectrics. Capacitor connections. Energy of electrostatic field. Concept of electrical current. Working resistance and conductance. Temperature dependability of resistance. Ideal i real electrical current sources. Current circuit. DC current power and energy. I and II law of Kirchhoff. DC current linear networks. Nonlinear element in DC current network. Magnetic field. Force on charge in motion and conductor circulated by electrical current. Current loop in magnetic field. Biot-Savart's law. Magnetic flux. Faraday's law of electromagnetic induction. Self-inductance and mutual inductance. Materija in magnetic field. Ferromagnetism.

### **Developing of general and specific competences (knowledge and skills)**

Familiarising with basic electrical values, ideas and validities. Gaining competence for solving arithmetical problems from area of electrical engineering. Performance of experiments and qualitative analysis of noted or measured values.

### **Forms of tuition performing and manner of knowledge checking**

Lectures, auditorial and laboratory practices. Auditorial practices in which students actively participate. Laboratory practices include experiment performing from areas elaborated on lectures. Control tasks.

### **List of literature needed for studies and sitting for an examination**

V. Pinter: Osnove elektrotehnike I, Tehnička knjiga Zagreb, 1987.

E. Šehović, M. Tkalić, I. Felja: Osnove elektrotehnike - zbirka primjera (prvi dio), Školska knjiga, Zagreb, 1984.

### **List of literature that is recommended as supplemental**

G. Đurović: Elektrotehnika I, Školska knjiga, Zagreb, 2004.

### **ECTS credits attributed to subject and corresponding explanation**

7 ECTS points. Lectures and practices 90 hours (4 points), time needed for studying and literature examination 60 hours (2 points), time needed for making homeworks 30 hours (1 point).

### **Manner of sitting for an examination**

Written and verbal exam. Written exam can be passed through control tasks.

### **Manner of quality inspection and efficiency of subject performing**

Anonymous pools at the end of the semester. Regular statistic reports about control tasks and written exams.

### **Prerequisites for subject enrolling**

No prerequisites.

## **FUNDAMENTALS OF ELECTRICAL ENGINEERING II**

### **Draft of subject contents**

Nonstationary (transition) state in DC current circuits. Periodically changable electrical values. Characteristic values of periodic sizes (effective and average values). Elements of electrical networks. Application of complex calculation in analysis of networks with sinusoidal currents and voltages. Term and properties of impedance and admittance. Current and voltage resonance. Instantaneous, working, virtual and semblance power. Matching of load. Analysis of electrical networks with linear elements (application of Kirchhoff laws, contour currents, node voltages, superposition, network theorems, transfiguration delta-star). Simetrical and asimetrical triphase systems. Rotational magnetic field. Coil with feromagnetic core in AC current circuits. Physical picture of transformator functioning. Nonlinearity in AC networks and application of Fourier analysis.

### **Developing of general and specific competences (knowledge and skills)**

Familiarising with basic electrical values, ideas and validities. Gaining competence for solving arithmetical problems from area of electrical engineering. Performance of experiments and qualitative analysis of noted or measured values.

### **Forms of tuition performing and manner of knowledge checking**

Lectures, auditorial and laboratory practices. Auditorial practices in which students actively participate. Laboratory practices include experiment performing from areas elaborated on lectures. Control tasks.

### **List of literature needed for studies and sitting for an examination**

V. Pinter: *Osnove elektrotehnike II*, Tehnička knjiga Zagreb, 1987.

I. Felja, D. Koračin: *Zbirka zadataka i riješenih primjera iz osnova elektrotehnike (prvi i drugi dio)*, Školska knjiga, Zagreb, 1987.

### **List of literature that is recommended as supplemental**

G. Đurović: *Elektrotehnika II*, Školska knjiga, Zagreb, 2004.

### **ECTS credits attributed to subject and corresponding explanation**

7 ECTS points. Lectures and practices 90 hours (4 points), time needed for studying and literature examination 60 hours (2 points), time needed for making homeworks 30 hours (1 point).

### **Manner of sitting for an examination**

Written and verbal exam. Written exam can be passed through control tasks.

### **Manner of quality inspection and efficiency of subject performing**

Anonymous pools at the end of the semester. Regular statistic reports about control tasks and written exams.

### **Prerequisites for subject enrolling**

No prerequisites.

## **GERMAN I**

### **Draft of subject contents**

Improving general German. Introduction into language of specific purposes in the fields of Mechanical Engineering and Naval Architecture: Engineering Materials. Hydrostatics. Hydrodynamics. Cutting and Machining of Metals. Tools, Machines, Devices. Gears. Bearings. Fastenings. Introduction into language of specific purposes in the field of Electrical Engineering: Basic Notions Concerning Energy. Isolators, Conductors and Semiconductors. Materials in Electrical Engineering. Ohm's Law. Lenz's Law. Electromotive Force and Power. Electromagnetic Induction. Electric Quantities and Units. Grammar and language structures. Verb tenses. Definite and indefinite article. Modal verbs. Compounds. Word formation. Passive. Subordinate Clauses. Development of technical texts understanding strategies. Introduction into abstract writing. Writing of Curriculum and business letters. Analysis of technical articles and general German texts.

### **Developing of general and specific competences (knowledge and skills)**

Students improve their knowledge of German and their language competence so as to communicate and express themselves in everyday language as well as those required for specific purposes in order to adapt to contemporary world of technology.

### **Forms of tuition performing and manner of knowledge checking**

Lectures deal with the topics of general German and German for specific purposes. Language practice (tutorials) is focused on language structures, reading and listening comprehension, translation and developing writing and communication skills. Tests, written and oral exam.

### **List of literature needed for studies and sitting for an examination**

Grujoski / Kovačić: Texte, Übungen und Aufgaben aus dem Bereich der Elektrotechnik, Šk. knjiga, Zagreb 1993.

Lardšnajder, R.: Texte, Übungen und Aufgaben aus dem Bereich des Maschinenbaus,, Šk. Knjiga, 1996.

### **List of literature that is recommended as supplemental**

Zettl/Jansen/Müller: Aus moderner Technik und Naturwissenschaft. Hueber. 2003.

Štambuk/Marinić: Deutsch und Technik. Šk. Knjiga 1993.

Newspaper and review article.

### **ECTS credits attributed to subject and corresponding explanation**

3 ECTS. Written and oral exam 35%, active participation during tuition 35%, literature and paper preparation and power-point presentation 30%

### **Manner of sitting for an examination**

Written and oral exam

### **Manner of quality inspection and efficiency of subject performing**

Speaking and writing skills, team work and presentation of set topics, review tests.

### **Prerequisites for subject enrolling**

No prerequisites.

## **GERMAN II**

### **Draft of subject contents**

Improving general German. Introduction into language of specific purposes in the fields of Mechanical Engineering and Naval Architecture: Information Age. Digital Computers and Microcomputers. Engine Fundamentals. Lubricants. Internal Combustion Engines. Diesel Motors. Pumps. Propulsion.

Introduction into language of specific purposes in the fields of Electrical Engineering: Thermal Power Plants. Transistors. Integrated Circuits. Electromagnetic Waves. Microelectronics. Generators and Motors.

Grammar and language structures. The Subjunctive. If-Clauses. Relative Clauses. Infinitive. Present and Past Participle. Peculiarities of vocabulary, grammar and communicational structures of German technical language. Writing of abstracts and business letters. Analysis of technical articles and general German texts.

### **Developing of general and specific competences (knowledge and skills)**

Students improve their knowledge of German and German for specific purposes. They become competent in analyzing authentic materials and write abstracts.

### **Forms of tuition performing and manner of knowledge checking**

Lectures deal with the topics of general German and German for specific purposes. Language practice (tutorials) is focused on language structures, reading and listening comprehension, translation and developing writing and communication skills. Tests, written and oral exam.

### **List of literature needed for studies and sitting for an examination**

Grujoski / Kovačić: Texte, Übungen und Aufgaben aus dem Bereich der Elektrotechnik, Šk. knjiga, Zagreb 1993.

Lardšnajder, R.: Texte, Übungen und Aufgaben aus dem Bereich des Maschinenbaus,, Šk. Knjiga, 1996.

### **List of literature that is recommended as supplemental**

Zettl/Jansen/Müller: Aus moderner Technik und Naturwissenschaft. Hueber. 2003.

Štambuk/Marinić: Deutsch und Technik. Šk. Knjiga 1993.

Newspaper and review articles.

### **ECTS credits attributed to subject and corresponding explanation**

3 ECTS. Written and oral exam 35% active participation during tuition 35%, literature and paper preparation and power-point presentation 30%.

### **Manner of sitting for an examination**

Written and oral exam

### **Manner of quality inspection and efficiency of subject performing**

Speaking and writing skills, team work and presentation of set topics, review tests.

### **Prerequisites for subject enrolling**

No prerequisites.

## **INDUSTRIAL PRACTICE I**

### **Draft of subject contents**

Industrial practice is a planned and supervised work experience in industry designed to help students understand the practical applications of their academic studies.

Industrial practice provides practical work experience, in a professional setting, related to the students field of study.

### **Developing of general and specific competences (knowledge and skills)**

Provide student with on-the-job work experience. Student develops practical skills and knowledge, taking specific working process into account.

### **Forms of tuition performing and manner of knowledge checking**

Course objectives are accomplished during 15 working days during summer recess. Students should prepare written reports detailing activities performing during professional practice.

### **List of literature needed for studies and sitting for an examination**

-

### **List of literature that is recommended as supplemental**

-

### **ECTS credits attributed to subject and corresponding explanation**

5 ECTS. Course objectives are accomplished in accordance with given instructions, lasting 15 working days during summer recess.

### **Manner of sitting for an examination**

Students are required to prepare a written reports using standard technical report format.

### **Manner of quality inspection and efficiency of subject performing**

Course evaluation by students, and appointed institution's bodies, in accordance with accepted practice for quality inspection and efficiency of subject performing at the institution's level.

### **Prerequisites for subject enrolling**

No prerequisites.

## **INTRODUCTION TO COMPUTING**

### **Draft of subject contents**

Computer and Information Technology. Information Coding and Data Presentation in Computers. Computer Organisation and Architectures. Operating systems. Computer Networks and Internet. Introduction to Programming and the Programming Language C.

### **Developing of general and specific competences (knowledge and skills)**

Introduce the students to basic terms in computer and information technology.

### **Forms of tuition performing and manner of knowledge checking**

Lecturing with knowledge checking based on quizzes, partial exams and homeworks. Exercises with problems solving and preparing for final project.

### **List of literature needed for studies and sitting for an examination**

Darko Grundler: *Primijenjeno računalstvo*, Graphis Zagreb 2000, ISBN: 953-6647- 03-6

### **List of literature that is recommended as supplemental**

V. Čerić (urednik): *Poslovno računarstvo*, Znak, Zagreb, 1998

### **ECTS credits attributed to subject and corresponding explanation**

6 ECTS. Lecturing and exercises - total 75 hours (3 credits); Time for learning and studying 60 hours (2 credits); Time for making homeworks and final project 30 hours (1 credit).

### **Manner of sitting for an examination**

Quizzes, partial exams, homeworks and final project form subject final mark

### **Manner of quality inspection and efficiency of subject performing**

Anonimus poll in the end of semester. Statistical reports on results obtained on quizzes, partial exams, homeworks and final project. In the end statistical report on passing.

### **Prerequisites for subject enrolling**

No prerequisites.

## **MATERIALS TECHNOLOGY**

### **Draft of subject contents**

Introduction. Materials in electrical engineering. Microstructure. Crystal and amorphous microstructure. Phase diagrams. Microstructure and properties of metals. Essential properties of macromolecule. Properties of polymers. Ceramics. Properties and microstructure of ceramics. Microstructure and properties of composites. Electrical and magnetic properties of materials. Definition of conductors, semiconductors and resistors. Mechanical properties of materials. Corrosion and anticorrosion behavior of materials. Basic manufacturing processes of materials. Heat treatment. Advance technologies. Materials types and possibility of application a manufacturing processes. Aspects of materials application. Methods of material selection.

### **Developing of general and specific competences (knowledge and skills)**

Student will be informed with the fundamentals of material science. Student will be skilled for appropriate materials selection in electrical engineering practice. Moreover, student will acquire basic methods of manufacturing processes.

### **Forms of tuition performing and manner of knowledge checking**

Lectures, consultation, seminar work, oral exam.

### **List of literature needed for studies and sitting for an examination**

Bek, V.: Tehnologija elektromaterijala, Sveučilište u Zagrebu, 1991.

### **List of literature that is recommended as supplemental**

Polak, J., Srb, N.: Izolacijski materijali i izoliranje električnih strojeva (priručnik), R. Končar, Tehnička knjiga, Zagreb, 1987.

### **ECTS credits attributed to subject and corresponding explanation**

3 ECTS.

### **Manner of sitting for an examination**

Documentary and oral exam.

### **Manner of quality inspection and efficiency of subject performing**

The analysis of subject metter adoption using periodical tests and by anonymous student's feedback.

### **Prerequisites for subject enrolling**

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## **MATHEMATICS FOR ENGINEERS ET**

### **Draft of subject contents**

Series. Series of functions. Fourier series. Fourier integral and Fourier transformation.  
Laplace transformation. Basic properties and application.  
Vector analysis. Scalar and vector fields, gradient, divergence, and curl.  
Curve integrals. Surface integrals. Triple integrals. Applications.  
Integral theorems. Formulas of *Green-Gauss*, *Stokes* and *Ostrogradsky*.  
Path independence, potential functions and conservative fields.  
Functions of complex variables. Conformal mappings and their applications.  
Bases of graph theory. Solving optimization problems by graphs.

### **Developing of general and specific competences (knowledge and skills)**

Knowledge: from mathematics necessary in theory and practice of technical sciences. Skills: to solve problems by using acquired mathematical knowledge and to apply it to specialized problems.

### **Forms of tuition performing and manner of knowledge checking**

Tuition performing: lectures, exercises, independent work, and consultations.  
Manner of knowledge checking: class participation, partial exams, written exam, and oral exam.

### **List of literature needed for studies and sitting for an examination**

Kamenarović, I.: *Inženjerska matematika I*, Tehnički fakultet Sveučilišta u Rijeci, 1997.  
Devidé V., i grupa autora: *Riješeni zadaci iz više matematike*. 1-4, Školska knjiga, Zagreb 1989 i 1990.  
Kreyszig E., *Advanced Engineering Mathematics*, John Wiley & Sons, Inc., 1993.

### **List of literature that is recommended as supplemental**

Kurepa, S: *Matematička analiza II, III*, Tehnička knjiga, Zagreb, 1986, 1984, 1975.

### **ECTS credits attributed to subject and corresponding explanation**

5 ECTS. Lecture attendance 20%, exercise attendance 20%, preparation of the written exam 30%, preparation of the oral exam 30%.

### **Manner of sitting for an examination**

Successful written exam is the condition for attending the oral exam.

### **Manner of quality inspection and efficiency of subject performing**

Control of the regularity of class performing and attendance. Continuous dialog with students and inquires about course. Quality control of seminar papers and of the knowledge at the oral exams.

### **Prerequisites for subject enrolling**

Mathematics II.

## **MATHEMATICS I**

### **Draft of subject contents**

Vectors and analytic geometry in space. Matrices. Determinants. Eigenvalues and eigenvectors. Solving systems of linear equations.

Functions of one variable. Limits and continuity. Elementary functions.

Derivative and differential: definitions and examples. Derivatives of elementary functions and the differentiation rules. Derivatives of explicit, implicit and parametric functions. Higher derivatives.

Applications of differential calculus: L'Hospital rule. Approximating functions by Taylor polynomial. Tangent and normal line. Extreme values and applications in optimization problems. Analysis of functions by using derivatives. Curvature of a plane curve.

Examples from engineering problems.

### **Developing of general and specific competences (knowledge and skills)**

The course program enables the student to acquire knowledge and skills from basic mathematical concepts, methods and procedures required for solving engineering problems. The program includes the vector algebra, linear algebra, functions and differential calculus of the function of one variable.

### **Forms of tuition performing and manner of knowledge checking**

Tuition performing: lectures, exercises, independent work, and consultations.

Manner of knowledge checking: class participation, written exam, and oral exam.

### **List of literature needed for studies and sitting for an examination**

Tomašić, L.: Matematika I, Tehnički fakultet Rijeka, 1996.

Slapničar I.: Matematika 1, Sveučilište u Splitu FESB, Split 2002.

Demidovič, B. P.: Zadaci i riješeni primjeri iz više matematike, Tehnička knjiga, Zagreb, sva izdanja

### **List of literature that is recommended as supplemental**

Devide, V. i grupa autora: Riješeni zadaci iz više matematike, 1- 4, Školska knjiga Zagreb, 1990.

Kurepa, S.: Matematička analiza I i II, Tehnička knjiga Zagreb, 1970/71.

### **ECTS credits attributed to subject and corresponding explanation**

7 ECTS. Lecture attendance 20%, exercise attendance 20%, preparation of the written exam 30%, and preparation of the oral exam 30%.

### **Manner of sitting for an examination**

Successful written exam is the condition for attending the oral exam.

### **Manner of quality inspection and efficiency of subject performing**

Control of the regularity of class performing and attendance. Student inquires about course. Quality control of the solutions of the given tasks and of the knowledge at the oral exams.

### **Prerequisites for subject enrolling**

No prerequisites.

## **MATHEMATICS II**

### **Draft of subject contents**

Indefinite integral. Integration of the simple functions and integration rules.

The concept of definite integral and its computation. Applications of definite integrals.

First order ordinary differential equations. Sources and modeling. Basic types and methods for solving. Applications in engineering. Higher order ordinary differential equations. Linear equation with constant coefficients and its application. Finding solutions by variation of parameters. Systems of differential equations.

Functions of two and more variables. Partial derivatives. Tangent plane. Total differential and linearization. Taylor polynomial and function approximation. Extreme and relative extreme with applications to optimization problems.

Double integral. Integration rules and substitution of the variables. Applications.

### **Developing of general and specific competences (knowledge and skills)**

The course program enables the student to acquire knowledge and skills from basic mathematical concepts, methods and procedures required for solving engineering problems. The program includes the integral calculus, differential equations and the function of two and more variables.

### **Forms of tuition performing and manner of knowledge checking**

Tuition performing: lectures, exercises, independent work, and consultations.

Manner of knowledge checking: class participation, written exam, and oral exam.

### **List of literature needed for studies and sitting for an examination**

Sopta, L.: Matematika 2, Tehnički fakultet Sveučilišta u Rijeci, 1995.

Kamenarović, I.: Inženjerska matematika I, Tehnički fakultet Sveučilišta u Rijeci, 1997.

Demidovič, B. P. : Zadaci i riješeni primjeri iz više matematike, TK Zagreb, sva izdanja.

### **List of literature that is recommended as supplemental**

Kreyszig E., Advanced Engineering Mathematics, John Wiley & Sons, Inc., 1993.

Kurepa, S: Matematička analiza I, II, III, Tehnička knjiga , Zagreb, 1986, 1984, 1975.

### **ECTS credits attributed to subject and corresponding explanation**

7 ECTS. Lecture attendance 20%, exercise attendance 20%, preparation of the written exam 30%, and preparation of the oral exam 30%.

### **Manner of sitting for an examination**

Successful written exam is the condition for attending the oral exam.

### **Manner of quality inspection and efficiency of subject performing**

Control of the regularity of class performing and attendance. Student inquires about course. Quality control of the solutions of the given tasks and of the knowledge at the oral exams.

### **Prerequisites for subject enrolling**

No prerequisites.

## **MECHANICS AND STRUCTURAL ELEMENTS**

### **Draft of subject contents**

Planar and spatial systems of forces. Equilibrium conditions. Rod- and beam-type structures. Friction. Power. Stress and strain. Hooke's law. Axial loading. Pure shear. Torsion. Symmetrical bending. Buckling. Dimensions determination according to external loading. Applications.

### **Developing of general and specific competences (knowledge and skills)**

Students are qualified for establishing equilibrium conditions for rigid and deformable solids or structures, and determination of dimensions and materials of loaded structures or structural members.

### **Forms of tuition performing and manner of knowledge checking**

Course is taught through lectures (3 hours per week) and auditorial exercises (1 hours per week). Knowledge checking is provided by two partial exams, each participating with 50% in the final grade. A student who fails, should pass an integral exam.

### **List of literature needed for studies and sitting for an examination**

Brnić, J.: "Statics" (in croatian), University of Rijeka, Faculty of Engineering, Rijeka, 2004.

Brnić, J., Turkalj, G.: "Strength of Materials I" (in croatian), University of Rijeka, Faculty of Engineering, Rijeka, 2004.

Brnić, J.: "Mechanics and Structural Elements " (in croatian), Školska knjiga, Zagreb, 1996.

### **List of literature that is recommended as supplemental**

Beer, F. P., Johnston, E.R., Eisenberg, E.R.: "Vector Mechanics for Engineers: Statics", McGraw-Hill, 2003.

Nash, W.: "Strength of Materials", Schaum's Outline Series, McGraw-Hill, New York, 1998.

### **ECTS credits attributed to subject and corresponding explanation**

4 ECTS. Exercises are structured as auditorial ones. Students duties involve study of recommended literature (approx. 200 pages) and autonomous problem solving.

### **Manner of sitting for an examination**

Examination consists of written and oral parts.

### **Manner of quality inspection and efficiency of subject performing**

Quality inspection and efficiency is provided by anonymous screening as well as by students exam efficiency.

### **Prerequisites for subject enrolling**

No prerequisites.

## **ORGANIZATION AND ECONOMICS OF ENTERPRISES**

### **Draft of subject contents**

Definition of production enterprise. Evolution of enterprise's organization. Factory as the enterprise. Building the enterprise.  
Basic principles of organization. Definition of system controlling. Information in enterprise. Types of organization structures. Designing the enterprise organization. Jobs evaluation.  
Property. Controlling. Managing. Principles of controlling and managing. Team work.  
Business policy. Planning. Scheduling. Principles and methods of planning. Plans of enterprise. Strategic plans and operative plans. Computer aided planning.  
Factory as an economics system. Incomes and expenses. Types of costs. Threshold of profitability. Balance of success. Balance of accounts. Effects of business.

### **Developing of general and specific competences (knowledge and skills)**

Qualification for analyzing the production enterprises organization. Ability for application methods of controlling and managing. Knowledge of production planning principles. Knowledge of effects of business process in production enterprises.

### **Forms of tuition performing and manner of knowledge checking**

Group form with continuous interactive teaching. Partial written examine and verbal examine.

### **List of literature needed for studies and sitting for an examination**

Selaković, M.: *Organizacija poslovnih sistema*, Tehnički fakultet Rijeka, Rijeka, 1993.  
Mikac, T.: *Organizacija poslovnih sustava*, skripta, Tehnički fakultet Rijeka, Rijeka, (in preparation).

### **List of literature that is recommended as supplemental**

Novak, M., Sikavica, P.: *Poslovna organizacija*, Informator, Zagreb, 1999.

### **ECTS credits attributed to subject and corresponding explanation**

3 ECTS. Exercises 50% auditoria. Preparing through literature studying (250 pages), and autonomous work of student as the preparation for examine.

### **Manner of sitting for an examination**

Written and verbal examine.

### **Manner of quality inspection and efficiency of subject performing**

Student's questionnaire.

### **Prerequisites for subject enrolling**

No prerequisites.

## **PHYSICAL AND HEALTH EDUCATION I, II**

### **Draft of subject contents**

The goal of the health-educational field of physical and health culture and education is to satisfy biopsychosocial needs of man for movement by using kinetic activity. Thereby we also satisfy general needs of man by enhancing adaptable and creative capabilities of man in the modern conditions of life and work.

### **Developing of general and specific competences (knowledge and skills)**

Program fundamentals can be realized through both compulsory (athletics, football, basketball, volleyball, handball, waterpolo with swimming and fitness program) and optional programs (skiing, sailing, rowing, mountaineering and rafting).

### **Forms of tuition performing and manner of knowledge checking**

Auditorial practises are obligatory.

### **List of literature needed for studies and sitting for an examination**

Medved, R.: Sportska medicina, Medicinska knjiga, Zagreb.

Štuka, K.: Fiziologija sporta, sportska tribina, Zagreb.

Guyton, A.C.: Medicinska fiziologija, Jumeana, Zagreb.

### **List of literature that is recommended as supplemental**

Kineziologija magazine, published by the Institute for kineziology, Zagreb.

### **ECTS credits attributed to subject and corresponding explanation**

1 ECTS. Total of 25 practises in semester).

### **Manner of sitting for an examination**

No examination.

### **Manner of quality inspection and efficiency of subject performing**

Regular attending of the auditorial practises.

### **Prerequisites for subject enrolling**

No prerequisites.

## **PHYSICS I**

### **Draft of subject contents**

Introduction, motion, linear motion. Circular motion. Relativity of motion. Motion of rigid body. Fluids, pressure. Hydrostatic pressure, Bernoulli equation. Heat and temperature. Gas laws. The transfer of heat; conducting and circulation. Radiation. Kinetic molecular theory. Oscillation, harmonic oscillation. Damped and forced oscillation. Mechanical waves, standing waves. The Doppler effect.

### **Developing of general and specific competences (knowledge and skills)**

Developing and increasing of competences from aspect of nature science that are necessary for understanding basics problems of profession.

### **Forms of tuition performing and manner of knowledge checking**

Lectures, auditory and laboratory exercises. Knowledge examination through two semestral colloquiums, written test and verbal examination after all lectures.

### **List of literature needed for studies and sitting for an examination**

J. Dobrinić, L. Mandić: Fizika 1, Tehnički fakultet, Rijeka, 2002.

P. Kulišić: Mehanika i toplina, Školska knjiga, Zagreb, 1998.

J. Dobrinić, L. Mandić: Zbirka riješenih primjera iz Fizike 1, Tehnički fakultet, Rijeka, 2001.

### **List of literature that is recommended as supplemental**

P. Kulišić i sur.: Riješeni zadaci iz mehanike i topline, Školska knjiga, Zagreb, 1998.

J. Dobrinić: Fizika (valovi, optika, struktura tvari), Tehnički fakultet, Rijeka, 1998.

### **ECTS credits attributed to subject and corresponding explanation**

5 ECTS. 30% auditory exercises, 70 % laboratory exercises. Literature reading - 200 pages.

### **Manner of sitting for an examination**

Exam has written part (or colloquiums) and verbal part. Grade of verbal examination is final.

### **Manner of quality inspection and efficiency of subject performing**

Consultation and opinion poll.

### **Prerequisites for subject enrolling**

No prerequisites.

## **PHYSICS II**

### **Draft of subject contents**

Electromagnetic oscillations. Electromagnetic waves, velocity of waves. Reflection, refraction, Doppler effect. Geometrical optics. Wave optics, interference of light. Diffraction of light. The diffraction grating, polarization of light. Elements of quantum physics, Planck's law. Structure of matter, the Bohr model of atom. Atomic spectrum, quantum numbers, crystals. Emission and absorption. Nuclear physics, nuclear decay. Interaction of radiation and matter. Photoelectric effect, Compton effect, pair production.

### **Developing of general and specific competences (knowledge and skills)**

Developing and increasing of competences from aspect of nature science that are necessary for understanding basic problems of profession.

### **Forms of tuition performing and manner of knowledge checking**

Lectures, auditory and laboratory exercises. Knowledge examination through two semestral colloquiums, written test and verbal examination after all lectures.

### **List of literature needed for studies and sitting for an examination**

J. Dobrinić: Fizika ( valovi, optika, struktura tvari), Tehnički fakultet, Rijeka, 1998.  
N. Glavan, L. Mandić, J. Dobrinić: Zbirka riješenih primjera iz Fizike II, TF, Rijeka, 2004.  
P. Kulišić, V. Lopac: Elektromagnetske pojave i struktura tvari, Školska knjiga, Zagreb, 1991.

### **List of literature that is recommended as supplemental**

V. Henč- Bartolić i sur.: Valovi i optika , Školska knjiga, Zagreb, 1998.  
J. Dobrinić, L. Mandić: Fizika 1, Tehnički fakultet, Rijeka, 2002.

### **ECTS credits attributed to subject and corresponding explanation**

5 ECTS. 30% auditory exercises, 70 % laboratory exercises. Literature reading - 150 pages.

### **Manner of sitting for an examination**

Exam has written part (or colloquiums) and verbal part. Grade of verbal examination is final.

### **Manner of quality inspection and efficiency of subject performing**

Consultation and opinion poll.

### **Prerequisites for subject enrolling**

No prerequisites.

## **POWER ELECTRONICS**

### **Draft of subject contents**

The field of power electronics. Active semiconductor and passive components. Energy flow in electric networks. Turn-off and commutation. Topology and function of converters. Methods of analysis of converters. Comparison of features of diode rectifiers. Diode rectifiers. Thyristor rectifiers. Regulation and energy features of thyristor converter. Thyristor converters. DC converters without galvanic separation. DC converters with galvanic separation. Autonomous invertors. Resonant invertors. AC converters. Application of power electronics in transport for reactive power compensation, continuous supply. Power semiconductor valves: diode, thyristor, GTO, MOSFET, IGBT. Protection of converters from surge voltage and power overload. Action of converters on the network and energy using devices and other problems of electromagnetic compatibility. Examples of application: DC megatransfers, reactive power static compensators, DC and AC electromotor drives. Power saving.

### **Developing of general and specific competences (knowledge and skills)**

Mastering a set of rules and methods for resolution of non-linear networks with semi-conductor valves serving to modify the electric power parameters and direct the course of electric power.

### **Forms of tuition performing and manner of knowledge checking**

Lectures including the testing of knowledge by means of control tests and homework  
Auditory exercises with students resolving specific problems on their own during the lectures. Lab exercises with the drafting of reports

### **List of literature needed for studies and sitting for an examination**

J. G. Kassakian et al.: Osnove energetske elektronike I (eng. Fundamentals of Power Electronics), Graphis, Zagreb, 2000.  
Z. Benčić, Z. Plenković: Energetska elektronika - Poluvodički ventili (eng. Power Electronics - Semiconductor Valves), Školska knjiga, Zagreb, 1978.  
I. Flegar: Sklopovi energetske elektronike-Odabrani primjeri (eng. Power Electronics Circuits - Selected Examples), Graphis, Zagreb, 1996.

### **List of literature that is recommended as supplemental**

N. Mohan, T. M. Undeland, W. P. Robbins: Power Electronics, John Wiley & Sons, Inc, 1995.  
M. H. Rashid: Power Electronics Handbook, Academic Press, 2001.

### **ECTS credits attributed to subject and corresponding explanation**

7 ECTS. Lectures - 45 hours; Exercises - 30 hours. Time required for studying and literature 45 hours; Time required for homework and lab exercise reports 30 hours.

### **Manner of sitting for an examination**

Control tests, homework, written and oral exam form the final grade.

### **Manner of quality inspection and efficiency of subject performing**

Anonymous opinion poll at the end of the semester. Regular statistical reports on passing grades at the tests and control exams and test scoring statistics. Final exam statistics of passing grades.

### **Prerequisites for subject enrolling**

Mathematics II, Fundamentals of Electrical Engineering II.

## **PROGRAMMING**

### **Draft of subject contents**

Programming Language C. Syntax. Types, Operators and Expressions. Control Flow. Functions and Program Structure. Pointers and Arrays Structures. Input and Output. The UNIX System Interface.

### **Developing of general and specific competences (knowledge and skills)**

Introduce the students to the C programming language.

### **Forms of tuition performing and manner of knowledge checking**

Lecturing with knowledge checking based on quizzes, partial exams and homeworks. Exercises with problems solving and preparing for final project .

### **List of literature needed for studies and sitting for an examination**

Rajko Vulin: Od sada programiramo v C-u, Turbo C, Školska knjiga, Zagreb 1991.  
Kernighan B. W., Ritchie D. M., The C Programming Language, Prentice Hall, Inc., 1988.

### **List of literature that is recommended as supplemental**

Rajko Vulin: Od sada programiramo v C-u, Turbo C, Školska knjiga, Zagreb 1991.  
Kernighan B. W., Ritchie D. M., The C Programming Language, Prentice Hall, Inc., 1988.

### **ECTS credits attributed to subject and corresponding explanation**

6 ECTS. Lecturing and exercises - total 75 hours (3 credits); Time for learning and studying 60 hours (2 credits); Time for making homeworks and final project 30 hours (1 credit).

### **Manner of sitting for an examination**

Quizzes, partial exams, homeworks and final project form subject final mark

### **Manner of quality inspection and efficiency of subject performing**

Anonimus poll in the end of semester. Statistical reports on results obtained on quizzes, partial exams, homeworks and final project. In the end statistical report on passing.

### **Prerequisites for subject enrolling**

Applied Computing I.

## **SYSTEM MODELLING AND SIMULATION**

### **Draft of subject contents**

Model classes and properties. Methods for determining mathematical models of the system. Description of system by using differential equations, transfer functions and in the state space. Modeling of the system with the concentrated parameters. Determining the model based on the physical laws. Material and energy equilibrium equations, pulse of the motion. Complex, and simplified models of the elements. Modeling of the system with the distributed parameters. Simulating of the system. Methods of numerical integration for simulating of the system. Generating the nonlinear and analytical functions. Simulation program packages.

### **Developing of general and specific competences (knowledge and skills)**

Understanding of methods and ways to model and simulate processes.  
Computer modeling and simulation of real-world processes.

### **Forms of tuition performing and manner of knowledge checking**

Lecturing with knowledge checking based on quizzes, partial exams and homeworks. Laboratory exercises with lecture-based problems in process simulation. Program development based on laboratory exercises and oral exam.

### **List of literature needed for studies and sitting for an examination**

D.J.Cloud: Applied Modeling and Simulation: An Integrated Approach to Development and Operation, McGraw-Hill, 1998.

N.M.Karayanakis: Advanced System Modeling and Simulation With Block Diagram Languages, CRS Press, 1995.

### **List of literature that is recommended as supplemental**

A. Cavallo, R. Sctola, F. Vasca: Using Matlab, Simulink and Control System Tool Box: A Practical Approach, Prentice Hall, 1996.

### **ECTS credits attributed to subject and corresponding explanation**

5 ECTS. Lecturing and exercises - total 60 hours (2 credits); Time for learning and studying 60 hours (2 credits); Time for making homeworks and final project 30 hours (1 credit).

### **Manner of sitting for an examination**

Quizzes, partial exams and homeworks. Laboratory program development and oral exam.

### **Manner of quality inspection and efficiency of subject performing**

Anonymous poll in the end of semester. Statistical reports on results obtained on quizzes, partial exams, homeworks and final project. In the end statistical report on passing.

### **Prerequisites for subject enrolling**

No prerequisites.

## **THERMODYNAMICS AND ENERGY**

### **Draft of subject contents**

Historical development of energy utilization. Thermal state. First law of thermodynamics. Ideal gas equation of state. Work. Specific heat. Gas mixtures. Ideal gas changes of state. Thermodynamic cycles. Reversible and irreversible processes. Irreversibility, entropy production and work. Second law of thermodynamics. Work in processes between two pressures. Maximal work. Enthalpy. Irreversibility of mixing of gases. Losses due to irreversibility. Vaporization and condensation. Saturated and overheated vapour. Vapour power cycles. Mollier's  $h$ - $s$ -diagram. Exergy. Combustion. Internal combustion processes. Flow processes in nozzles. Conduction. Convection. Thermal radiation. Heat transmission. Heat exchangers. Humid air. Conventional and renewable energy sources. Nuclear energy. Fundamentals of energy engineering. Energy planning. Energy management.

### **Developing of general and specific competences (knowledge and skills)**

Accepting the theoretical knowledge and training of skills for solving practical problems in field of thermodynamics. Accepting knowledges that are needed for attending subjects in fields of thermal systems and energy.

### **Forms of tuition performing and manner of knowledge checking**

Tuition is performed through lectures and auditory exercises where examples regarding matter represented at the lectures are solved. Knowledge checking is performed by written and oral part of examination.

### **List of literature needed for studies and sitting for an examination**

Bošnjaković, F.: Thermodynamics, part I, IV edition (book), Tehnička knjiga Zagreb, 1970 (in Croatian)  
Bošnjaković, F.: Thermodynamics, part II, IV edition (book), Tehnička knjiga Zagreb, 1976 (in Croatian)  
Halasz, B., Galović, A., Tadić, M.: Collect. of exampl. in thermod. I, II, Sveuč. tiskara, Zgb, 1993, 1996 (in Cr)  
Udovičić, B.: Energy engineering, Školska knjiga, Zagreb, 1993 (in Croatian)

### **List of literature that is recommended as supplemental**

Galović, A.: Thermodynamics I, (book), Fakultet strojarstva i brodogradnje, Zagreb, 2002 (in Croatian)  
Galović, A.: Thermodynamics II, (book), Fakultet strojarstva i brodogradnje, 2003 (in Croatian)

### **ECTS credits attributed to subject and corresponding explanation**

5 ECTS. From total number of student's working hours 36 % refers to lectures, 12 % refers to exercises, 2 % refers to examination and 50 % refers to examples solving and literature studying i.e. learning by itself.

### **Manner of sitting for an examination**

Knowledge checking is performed by written and oral part of examination.

### **Manner of quality inspection and efficiency of subject performing**

Quality inspection and efficiency of subject performing is assumed to be carried out by students and teachers evaluation with the aim of quality insurance and continuous improvement.

### **Prerequisites for subject enrolling**

Mathematics II.