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Faculty of Electrical Engineering
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31 000 OSIJEK

First Cycle Degree in Electrical Engineering (Bachelor level) – Study Programme

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1. INTRODUCTION

a) Rationale for founding the Faculty

Faculty of Electrical Engineering in Osijek was founded in 1978, but the university programme of electrical engineering has been carried out since 1990. During that period, the Faculty has developed into a respectable institution in material and staff terms, which is the basis for implementing study programmes at the highest level. During the previously mentioned period, the Faculty has been equipped with modern lecture rooms and staff offices, but what is more important it has equipped laboratories, which are of greatest importance in the modern education of students studying electrical and computer engineering.

Assessment of rationale with respect to labour market requirements - The labour market in Croatia shows that experts who complete their studies of electrical engineering find an employment easily so that there are hardly any unemployed engineers of the mentioned profile. Faculty of Electrical Engineering in Osijek is the only institution in the Eastern Croatia that educates professionals in the field of electrical engineering, and that makes the basis for future successful activities but also for employment of highly educated staff as well as development of both this region and Croatia in general. Some data from nearer, but also broader area, the European Union, the USA and other highly developed countries show that experts who complete the study programme of electrical engineering have great possibilities to find an employment due to the constant need for staff of this profile. Furthermore, trends of growth and development of electrical engineering, computer engineering, information and communication technologies as well as the impact of new technologies and services show that more experts of this profile will be needed. It is to be expected that this trend is going to be continued, which is the main reason for starting a study of this profile. Engineers who will complete the Bachelor level of electrical engineering will acquire basic knowledge to be able to become part of the labour market. Worldwide experience shows that short–cycle engineers easily find an employment due to the lack of educated labour force as well as narrow specialisation of particular jobs which require some basic knowledge offered by the Bachelor level of electrical engineering study programme.
Further social and economic development of modern society as well as Croatia in general is inconceivable without electrical engineering which is present in every segment of human life**.** Electrical engineering will undoubtedly remain the main initiator of social development which will require highly educated experts who will be able to respond to the challenges of the new age. Highly educated experts of electrical engineering educated at the Faculty of Electrical Engineering in Osijek have found and will find their place at the labour market.

Connection with modern scientific ideas and/or skills based on them- The modern study of electrical engineering is based on the overall research and development in the field of natural and technical sciences but on new technologies as well. It is especially manifested in the development of electrical engineering and electronic industry which is supported by most recent ideas in the scientific field of electrical engineering. The initiator of the development and research in this field is the labour market, which supports further investment into science and research in the field of electrical engineering. Consequently, most recent scientific ideas have to be followed by research and development at the

Faculty, in the first place within the framework of different projects supported by the Ministry of Science, Education and Sports, through projects supported by the European Union and certainly through cooperation and projects with economy.

Comparability with programmes of other eminent foreign higher education institutions – The Bachelor level programme in electrical engineering at the Faculty of Electrical Engineering in Osijek is based on and can be compared with related European universities. Furthermore, it can be compared with the first cycle programme of electrical engineering at TU Vienna and with the first cycle programme of electrical engineering and computer science at EHT Zürich. The common base is the three-year study programme during which students can acquire the minimum of 180 ECTS credits. The common qualification awarded after the successful completion of the first cycle studies is Baccalaureus / Baccalaurea of Electrical Engineering (and Computer Science), i.e. Bachelor of Science in Electrical Engineering. The basis of research of the first cycle programme is represented by entirely comparable fundamental courses of the study programme in the first and the second years of study and obligatory and/or elective modules/courses through which students obtain some additional orientation towards the labour market, i.e. towards Master level (second cycle studies).

b) Experience in the implementation of equivalent or similar programmes

Faculty of Electrical Engineering in Osijek has been educating engineers in the field of electrical engineering for many years. In the new curriculum and study programme of the undergraduate study which was accepted in 2003, engineers in the scientific field of electrical engineering are educated at the Faculty of Electrical Engineering. They can choose one of the three following branches: Power Engineering**,** Automation and Computer Engineering in Process Control**,** and Computer Engineering and Telecommunications**.** Furthermore, the postgraduate study of electrical engineering is carried out at the Faculty of Electrical Engineering in the following branches: Power Engineering, Telecommunications and Computer Science**.** On account of the mentioned studies, the Faculty of Electrical Engineering has acquired valuable experience in the education of experts in the scientific field of electrical engineering. Former studies of electrical engineering represent the foundation for the new First cycle studies of electrical engineering, that will, together with the Second cycle studies and the Third cycle studies**,** create a continuing educational cycle from the Bachelor to the Master and finally to the doctoral degree. In this way, the Faculty of Electrical Engineering will encircle the education of experts in the scientific field of electrical engineering.

d) Faculty overtness towards mobility of students

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

2. PRELIMINARIES

2.1. *Study programme*:

First cycle degree in Electrical Engineering

2.2. *Institution*:

J. J. Strossmayer University of Osijek, Faculty of Electrical Engineering Osijek in co-operation with other University institutions (faculties, departments)

2.3. *Duration of study*:

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

2.4. *Entry requirements*:

Bachelor's study programme in electrical engineering would be open to applicants who completed their four-year secondary school education and passed a compulsory entrance examination attaining a required threshold level. Admission of qualified applicants to the university study programme in electrical engineering would be done according to a rank-list compiled on the basis of the overall secondary school achievements as well as entrance examination results. Introducing a GCE A-level examination in the secondary school education in the Republic of Croatia would allow applicants admission without being obliged to take the entrance examination, stressing thereby the importance of the overall secondary school achievements and GCE A-level results.

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

Graduates from the Faculty of Electrical Engineering in Osijek and its Bachelor level programme in electrical engineering would acquire the necessary knowledge and skills to apply their knowledge of mathematics, physics, science and engineering to electrical engineering, as well as to design and conduct experiments, and analyse and interpret measurement results. Engineers of this profile would learn how to identify, formulate, and solve engineering problems. Furthermore, they would acquire abilities to recognise the interaction between engineering activities and design, manufacturing, marketing, user requirements and requirements of the manufacturing process. They should also learn how to adapt to technology changes and new techniques as part of a life long learning process. Moreover, electrical engineering students would display an understanding of engineering activities and their influence on life in general and the environment, demonstrating high moral and ethical principles while solving engineering tasks. Students would be able to apply the acquired knowledge to undertake appropriate further training aimed at improving their professional and academic abilities. By solving complex problems, electrical engineering students would creatively and critically evaluate arguments, assumptions, concepts and data in order to make effective judgement and offer adequate contribution to the overall solution.

First cycle degree holders in electrical engineering would acquire the necessary knowledge and abilities to:

- apply the basic laws of electrical engineering to RCL networks;
- provide a thorough analysis and calculation of dimensions of electrical distribution system;
- develop and implement computer networks and communication protocols;
- explain fundamental principles of power generation and distribution;
- work with basic analogue and digital circuits as parts of larger systems;
- apply simulation software tools for the purpose of designing electronic components;
- use laboratory equipment for testing, design and development;
- work with basic and advanced software tools for solving engineering problems;
- plan, install and maintain basic control systems.

The knowledge and skills first cycle degree holders in electrical engineering would acquire during their studies would prepare them for a continuing Master level, i.e. second cycle degree in computer engineering, both in Croatia and abroad. Moreover, through a basic knowledge of mathematics, physics and electrical engineering they would be completely or partially educated and trained to continue with their study programme at second cycle degree granting institutions majoring in other branches of engineering and computer science.

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

After the successful completion of the first cycle study programme (Bachelor level) in electrical engineering graduates would be awarded the title **Bachelor of Science in Electrical Engineering**.

3. Program Description

3.1. First-cycle Degree Study Programme in Electrical Engineering- obligatory and elective courses

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

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

Course notation

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

Course code: P Bx y z

where: P – one-letter symbol for the first-cycle degree study programme
B – one- or multi-letter symbol for the study programme
E – Electrical engineering courses
K – Communications courses
R – First-cycle degree study programme in computer engineering

x – semester
y z – two-digit symbol for the course number in the semester

Workload notation

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

1st Year

Semester 1

Code	*Lecturer*	*Course*	*Weekly workload*					*Examination*	*ECTS credits*
			P	A	L	K	Σ		
P101	Radoslav Galić, PhD, Full Professor	Linear Algebra	2	2	0	0	4	1	5
P102	Rudolf Scitovski, PhD, Full Professor	Calculus I (Differential Calculus)	2	2	0	0	4	1	5
P103	Snježana Rimac-Drlje, PhD, Associate Professor	Fundamentals of Electrical Engineering I	2	2	1	0	5	1	6
P104	Josip Brana, PhD, Assistant Professor	Physics I	3	1	1	0	5	1	5.5
P105	Tomislav Mrčela, PhD, Associate Professor	Engineering Graphics and Documentation	2	0	0	1	3	1	3
P106	Goran Martinović, PhD, Assistant Professor	Programming I	2	0	2	0	4	1	5.5
		TOTAL:	**13**	**7**	**4**	**1**	**25**	**6**	**30**
P107	Željko Širić, Senior Lecturer	Physical Education I	0	0	2	0	2	0	0
	Optional course:								
PF101	Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Senior Lecturer	English	1	1	0	0	2	0	

Semester 2

Code	*Lecturer*	*Course*	*Weekly workload*					*Examination*	*ECTS credits*
			P	A	L	K	Σ		
P201	Tomislav Marošević, PhD, Assitant Professor	Calculus II (Integral Calculus -Differential Equations)	2	2	0	0	4	1	5.5
P202	Muharem Mehmedović, PhD, Assitant Professor	Fundamentals of Electrical Engineering II	3	2	1	0	6	1	7
P203	Josip Brana, PhD, Assistant Professor	Physics II	3	1	1	0	5	1	5.5
P204	Tomislav Švedek, PhD, Full Professor	Electronics I	3	2	1	0	6	1	6.5
P205	Davor Antonić, PhD, Associate Professor	Programming II	2	0	2	0	4	1	5.5
		TOTAL:	**13**	**7**	**5**	**0**	**25**	**5**	**30**
P206	Željko Širić, Senior Lecturer	Physical Education II	0	0	2	0	2	0	0
	Optional course:								
PF201	Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Senior Lecturer	English	1	1	0	0	2	0	

2nd Year

Semester 3

Code	*Lecturer*	*Course*	*Weekly workload*					*Examination*	*ECTS credits*
			P	A	L	K	Σ		
P301	Tomislav Marošević, PhD, Assistant Professor	Calculus III	3	2	0	0	5	1	6
P302	Damir Šljivac, PhD, Assistant Professor	Fundamentals of Power Engineering and Ecology	3	1	0	0	4	1	5
PEK301	Zdenko Godec, PhD, Full Professor	Measurement Basics	3	1	2	0	6	1	7
	Elective module III-1								
PE301	Marinko Stojkov PhD, Assistant Professor	Basics of Thermodynamics	3	2	0	0	5	1	7
PE302	Antun Pintarić, PhD, Associate Professor	Electrical Materials	2	1	1	0	4	1	5
		TOTAL:	**14**	**7**	**3**	**0**	**24**	**5**	**30**
	Elective module III-2								
PK301	Tomislav Švedek, PhD, Full Professor	Electronics II	3	1	1	0	5	1	6
PKR301	Željko Hocenski, PhD, Full Professor	Digital Electronics	2	1	1	1	5	1	6
		TOTAL:	**14**	**6**	**4**	**1**	**25**	**5**	**30**
P304	Željko Širić, Senior Lecturer	Physical Education III	0	0	2	0	2	0	0

Semester 4

Code	*Lecturer*	*Course*	*Weekly workload*					*Examination*	*ECTS credits*
			P	A	L	K	Σ		
P401	Drago Žagar, PhD, Associate Professor	Communication Networks	3	1	1	0	5	1	6
P402	Radoslav Galić, PhD, Full Professor	Probability and Statistics	2	2	0	0	4	1	5.5
P403	Hrvoje Babić, PhD, Full Professor	Signals and Systems	2	1	1	0	4	1	5.5
P404	Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Senior Lecturer	English I	1	1	0	0	2	1	2
PEK401	Ivan Flegar, PhD, Full Professor	Network Analysis	3	2	0	0	5	1	5.5
	Elective modul IV-1								
PE401	Zdravko Valter, PhD, Full Professor	Fundamentals of Electrical Machines	3	1	1	0	5	1	5.5
		TOTAL:	**14**	**8**	**3**	**0**	**25**	**6**	**30**
	Elective modul IV-2								
PRK401	Franjo Jović, PhD, Full Professor	Information Theory	3	1	1	0	5	1	5.5
		TOTAL:	**14**	**8**	**3**	**0**	**25**	**6**	**30**
P405	Željko Širić, Senior Lecturer	Physical Education IV	0	0	2	0	2	0	0

3rd Year Semester 5

Code	*Lecturer*	*Course*	*Weekly workload*					*Examination*	*ECTS credits*
			P	A	L	K	Σ		
P501	Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Senior Lecturer	English II	1	1	0	0	2	1	3
	Elective module V-1								
PE501	Zdravko Valter, PhD, Full Professor	Fundamentals of Electric Drives	3	1	1	0	5	1	7
PE502	Lajos Jozsa, PhD, Associate Professor	Electric Power Networks	2	1	1	0	4	1	6
PE503	Ivan Flegar, PhD, Full Professor	Principles of Power Electronics	3	1	1	0	5	1	7
PER501	Dražen Slišković, PhD, Assistant Professor	Basics of Automatic Control	2	1	1	0	4	1	7
		TOTAL:	**11**	**5**	**4**	**0**	**20**	**5**	**30**
	Elective module V-2								
PRK501	Ninoslav Slavek, PhD, Assistant Professor	Data Bases	3	1	1	0	5	1	7
PRK502	Franjo Jović, PhD, Full Professor	Modelling and Simulation	2	1	1	0	4	1	7
PRK503	Željko Hocenski, PhD, Full Professor	Computer Architecture	2	1	1	1	5	1	7
PK501	Snježana Rimac-Drlje, PhD, Associate Professor	Communication Systems	3	1	1	0	5	1	7
		TOTAL:	**11**	**5**	**4**	**1**	**21**	**5**	**30**

Semester 6

Code	*Lecturer*	*Course*	*Weekly workload*					*Examination*	*ECTS credits*
			P	A	L	K	Σ		
P601	Vlado Majstorović, PhD, Full Professor	Company Economics	2	1	0	0	3	1	5
P602	Tomislav Mrčela, PhD, Associate Professor	Technical System Designing	2	1	0	0	3		5
P603	Antun Pintarić, PhD, Associate Professor	Communication Skills	2	1	0	0	3	1	5
P604	Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Senior Lecturer	English III	2	1	0	0	3	1	5
P605		Final work	0	0	0	9	9	1	10
	Optional course:								
PS601		Optional course-University					4	1	4
		TOTAL:	**8**	**4**	**0**	**9**	**21**	**5**	**30**

3.2. First Cycle Degree in Electrical Engineering (Bachelor level) – Courses description

Semester 1

P101	**Linear Algebra**
Lecturer:	Radoslav Galić, PhD, Full Professor
Course description: Elements of mathematical logic. Vector space V3. Operations on vectors. Linearly dependent and independent vectors. Vector projection. Base of a vector space. Coordinate system. Scalar, vector and triple product. Analytic geometry. Point, line, plane and mutual relations. Matrix and elementary transformations of matrices. Operations with matrices. Vector space of matrices. Determinant and its properties. Calculation of determinant value. Rank of a matrix. Regular matrices. Inverse matrices. Systems of linear equations. Discussion of solutions. Methods for solving systems of equations. n-dimensional vector space. Base and space dimension. Subspaces. Examples of vector space. Linear operator. Representation of a linear operator in a basis. Algebra. Minimum polynomial. Similarity of matrices. Eigenvalues and eigenvectors. Characteristic polynomial. Hamilton-Cayley theorem. Matrix diagonalisation. Scalar product. Norm. Unitary spaces. Orthogonality. Gramm-Schmidt orthogonalisation. Quadratic forms. Curves of second degree. Second-degree surfaces.	
Knowledge and skills acquired: Students are introduced to linear algebra calculus and algebraic structures fundamental to many other courses. Lectures and exercises will include basic terminology whose usage will be illustrated by various examples and tasks.	
Teaching methods: Students are obliged to attend both lectures and exercises.	
Student assessment: During the semester students can take several tests which replace the written examination. This ensures continuous assessment of students' work and knowledge.	
Obligatory literature: 1. K.Horvatić, Linearna algebra, PMF Matematički odjel, Zagreb,1995. 2. N.Bakić, A.Milas, Zbirka zadataka iz linearne algebre, PMF Matematički odjel, Zagreb,1995.	
Recommended additional literature: 1. S.Kurepa, Uvod u linearnu algebru, Školska knjiga, Zagreb,1990. 2. L.Čaklović, Zbirka zadataka iz linearne algebre, Školska knjiga, Zagreb 1979. 3. R.Galić, Osnive linearne algebre, ETF, Osijek, 1994. 4. N.Elezović, Linearna algebra, Element, Zagreb, 1995.	
ECTS credits: **5 ECTS credits** An ECTS credit value has been added according to calculation of time required for studying and successful course completion.	
Examination methods: The final examination consists of the written and the oral part. Students could take the final examination after the completion of lectures and exercises.	
Course assessment: Conducting an anonymous questionnaire filled in by students after course completion, an analysis of students' final assessments and their overall success.	

P102	**Calculus I** (Differential Calculus)
Lecturer:	Rudolf Scitovski, PhD, Full Professor
Course description: 1. Preliminaries. Real numbers, infimum and supremum, absolute value, intervals. Complex numbers. 2. Functions. Definition of a function. Basic properties. Composition of functions. Inverse function. Elementary functions (polynomial, rational, exponential, logarithm, trigonometric, cyclometric, hyperbolic and area functions). 3. Sequences of real numbers. Concept of a sequence, properties and convergence. Number e.	

4. Limits and continuity of functions. Concept and properties of the limits of the function. Asymptotes. Continuity of functions.

5. Differential calculus. The derivative and the tangent. The derivative as velocity. Concept of the derivative. Derivative rules. The chain rule and the derivative of the inverse function. The derivative of elementary functions. Implicit differentiation. Parametric differentiation. Mean value theorem. Higher derivatives. Taylor's theorem.

6. Application of the differential calculus. Differential. Newton's method. L'Hôpital's rule. Examination of functions (monotonicity, minima and maxima, convexity, asymptotes). Sketching curves.

Knowledge and skills acquired:
At the *introductory level* students should be introduced to fundamental ideas and methods of mathematical analysis, which represent the basis for many other courses. During lectures basic terminology would be explained in an *informal way*, their utility and applications would be illustrated. During exercises students should master an adequate technique and become trained for solving concrete problems.

Teaching methods:

Students are obliged to attend both lectures and exercises.

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

Obligatory literature:

1. D. Jukić, R. Scitovski, Matematika I, Odjel za matematiku, Osijek, 2000.

Recommended additional literature:

1. S. Kurepa, Matematička analiza 1 (diferenciranje i integriranje), Tehnička knjiga, Zagreb, 1989.
2. R.Courant, F.John, Introduction to Calculus and Analysis I, Springer-Verlag, Berlin, 1999.
3. S.Lang, A First Course in Calculus, Springer-Verlag, New York, 1986
4. B.P. Demidovič, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke, Tehnička knjiga, Zagreb, 1986.

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

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

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

P103	**Fundamentals of Electrical Engineering I**

Lecturer: Snježana Rimac-Drlje, PhD, Associate Professor

Course description:
Introduction. Force on the point charge and the vector of the electric field, Coulomb's law, Gauss's law. Electric induction, dielectricity. Field of a point (spherical) charge, line charge and a flat sheet of charge. Electric potential and voltage, power in electric field. Potential surfaces and field lines, potential around point charge. On capacitance, capacitance of a plane capacitors and capacitance of two wire system. Energy in electrostatic field. Electric circuit, intensity, direction and density of curent. Various effects of electric current, electrical resistance and conductance, influence of temperature. The ideal voltage and current source. Ohm's law. Kirchhoff's laws. Power and energy in circuits, Joule's law, maximum of usable power and efficiency. Force on a moving charge, density of the magnetic flux, the magnetic field vector, Ampere's law, magnetic flux, imaging with field lines. Magnetic field around linear conductor and in the thorodial coil. Force influence on a conductor and between two conductors. Biot-Savart's law. Magnetic field of a coil. Permeability, ferromagnetism, magnetisation curve and hysteresis loop. Magnetic circuit and its reluctance. Faraday's law and Lenz's law. Self-induction and mutual induction, inductance and mutual inductance. Energy of the magnetic field.

Knowledge and skills acquired:

Students will acquire knowledge of the fundamental laws in electromagnetism, units and measures of the electric and magnetic fiels. Furthermore, they will be able to make calculations of the electric field, magnetic field, capacitance, inductance and resistance of simple conductive forms. They will be able to measure with ampermetre, voltmetre, watmetre, ohmmetre, teslametre and oscilloscope.

Teaching methods:

Students are obliged to attend both lectures and exercises.

Student assessment:

Testing laboratory practice, written and oral examinations

Obligatory literature:

1. B. Kuzmanović, Osnove elektrotehnike I, Element, Zagreb, 2000.
2. Šehović, Felja, Tkalić, Osnove elektrotehnike zbirka primjera prvi dio, Školska knjiga, Zagreb, 1992.
3. S. Rimac-Drlje, Ž. Hederić. A. Keller: Osnove elektrotehnike 1 - Upute za laboratorijske vježbe

Recommended additional literature:

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

ECTS credits: **6 ECTS credits**

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

Examination methods:

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

Course assessment:

Students' evaluation, analysis of their work in laboratory and grades scored in the written and the oral examination.

P104	**Physics I**

Lecturer: Josip Brana, PhD, Assistant Professor

Course description:

The course consists of two parts:

Mechanics: vectors; kinematics; dynamics; work; power; energy; system of particles; rigid body dynamics; (non)inertial systems; Newton's law of gravitation; harmonic oscillator; waves; fluid mechanics.

Thermodynamics: ideal gas law; kinetic theory of gases; laws of thermodynamics; Carnot's heat engines; entropy.

Knowledge and skills acquired:

Students must acquire knowledge of the concepts and mathematically formulated laws of mechanics and thermodynamics, which enables them to understand mechanical and heat phenomena in nature and technology as well as to solve simple problems.

Teaching methods:

Lectures, problem solving, laboratory practice.

Student assessment:

Laboratory test, written and oral examination.

Obligatory literature:

1. Mehanika i toplina, P. Kulišić;
2. Riješeni zadaci iz mehanike i topline, P. Kulišić i dr.

Recommended additional literature:

1. The Feynman Lectures on Physics, R. P. Feynman, R. B. Leighton, M. Sands; The Berkeley Physics Course.

ECTS credits: **5.5 ECTS credits**

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

Examination methods:

The final examination consists of the written and the oral part. Students can take the final examination after the completion of lectures and exercises.

Course assessment:

Conducting an anonymous questionnaire filled in by students after course completion. Permanent contact with students.

P105	Engineering Graphics and Documentation
Lecturer:	Tomislav Mrčela, PhD, Associate Professor

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

Knowledge and skills acquired:
During the course students acquire general knowledge and skills that enable them to access projects and tasks in the field of electrical engineering. They also gain basic knowledge of AutoCAD graphical design tools as well as specialised graphical tools used in electrical engineering. Moreover, students become trained for successful project realisation in accordance with IEC regulations.

Teaching methods:
Lectures, design exercises.

Student assessment:
Partial exam.

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

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

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

Examination methods:
Project task and oral examination.

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

P106	Programming I
Lecturer:	Goran Martinović, PhD, Assistant Professor

Course description:
Basic terminology and historical overview of computer science. Fundamentals of computer organisation: CPU, peripheral units. System and application software. Networking and the Internet. Number systems and data formats. Basics of mathematical logic. Algorithms: notation forms, timing and space complexity on examples. Programming fundamentals, programming language structure, program development, languages of different abstraction level, compiler, interpreter and browser on examples. Programming in C: programme structure, keywords, data types, C preprocessor, variables, arithmetic and logic expressions, input and output, control - flow statements, functions, basics of pointers, arrays and structures, files.

Knowledge and skills acquired:
Necessary knowledge of computer architecture and working principles. Successful usage of up-to-date system and application tools. Fundamentals of programming and simple programs developed in C.

Teaching methods:

Lectures and laboratory practice are obligatory.

Student assessment:
Two successfully graded exercises during one semester can replace the final written examination. Tests in laboratory practice add additional points to the final examination, which consists of the written and the oral part.

Obligatory literature:

1. D. Grundler, Primijenjeno računalstvo, Graphis, Zagreb, 2000.
2. C. Horstmann, Computing Concepts with Essentials (3rd Edition), John Wiley & Sons, Inc., New York, 2002.
3. D. Fischer, Zbrika zadataka iz C-a, ETF Osijek, 1999.
4. B. Motik, J. Šribar, Demistificirani C++, Element, Zagreb, 1997.

Recommended additional literature:

1. L. Budin, Informatika za 1. razred gimnazije, Element, Zagreb, 1997.
2. D. Patterson, J. Hennessy, Computer Organization and Design: The Hardware / Software Interface (2nd Edition), Morgan Kaufmann Publ., San Francisco, 1997.
3. A.S. Tanenbaum, Structured Computer Organization, 7th ed., Prentice-Hall, New Jersey, 2005.

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

Examination methods:
Written and oral examination.

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

P107, P206, P304, P405	**Physical Education I, II, III and IV**

Lecturer: Željko Širić, Senior Lecturer

Course description:

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

1. Apparatus gymnastics.

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

2. Ball games.

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

3. Athletics.

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

2. Programme for students of damaged health

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

PF101	**English I** – optional

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

Course description:
Introduction, asking and giving information, describing people, expressing regret, distinguishing levels of formality, spelling and counting.

Knowledge and skills acquired:
Basic communicative patterns acquiring basic language structures.

Teaching methods: Lectures and language practice.
Student assessment: Written and oral assessment.
Obligatory literature: 1. The New Cambridge English Course, Book 1
Recommended additional literature: 1. Student's Book 2. Practice Book
ECTS credits: **0 ECTS credits** This course is optional and does not carry any ECTS credits.
Examination methods: Written and oral examination.
Course assessment: Students' evaluation at the course end.

Semester 2

P201	**Calculus II** (Integral Calculus – Differential Equations)
Lecturer:	Tomislav Marošević, PhD, Assitant Professor
Course description: 1. Riemann integral. The integral as an area. Concept and properties of the Riemann integral. Integrability of monotonic and continuous functions. The mean value theorem for integral of the continuous function. Newton-Leibniz formulae. 2. Indefinite integral. Basic methods and techniques of integration (the method of substitution, integration by parts, integration of rational functions and integration of functions boiling down to integrals of rational functions, Euler substitution, binomial integral) 3. Application of integration. Area between two curves, surface and volumes of revolution, length of curve, work of power, moments, centre of mass. Improper integral. Numerical integration (trapezium and Simpson's rule). 4. Series of real numbers. Concept of series and convergence. Criteria of convergence. 5. Series of functions. Uniform convergence. Power series. Taylor series of elementary functions. Exponential and logarithm function. 6. Ordinary differential equations. Sources of ordinary differential equations. General and particular solution. Cauchy problem. Geometric point of view. Problem of sensitivity to a change of initial values. Some types of ordinary differential equations of the first order (exact, homogeneous, linear, Bernoulli equation). Examples and applications. 7. Ordinary differential equations of the second order. Some special types. Linear differential equation of the second order. Lagrange's method of variation of the constant. Linear differential equation of the second order with constant coefficients. Examples and applications (harmonic oscillator).	
Knowledge and skills acquired: At the *introductory level* students should be introduced to fundamental ideas and methods of mathematical analysis, which represent the basis for many other courses. During lectures basic terminology would be explained in an *informal way*, their utility and applications would be illustrated. During exercises students should master an adequate technique and become trained for solving concrete problems.	
Teaching methods: Students are obliged to attend both lectures and exercises.	
Student assessment: During the semester students can take several tests which replace the written examination. This ensures continuous assessment of students' work and knowledge.	
Obligatory literature:	

1. D. Jukić, R. Scitovski, Matematika I, Odjel za matematiku, Osijek, 2000.
2. I.Ivanšić, Fourierovi redovi. Diferencijalne jednadžbe, Odjel za matematiku, Osijek, 2000.

Recommended additional literature:

1. W.Rudin, Principles of Mathematical Analysis, Mc Graw-Hill, Book Company, New York, 1964.
2. S. Kurepa, Matematička analiza 1 (diferenciranje i integriranje), Tehnička knjiga, Zagreb, 1989.
3. S. Kurepa, Matematička analiza 2 (funkcije jedne varijable), Tehnička knjiga, Zagreb, 1990.
4. B.P. Demidovič, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke, Tehnička knjiga, Zagreb, 1986
5. G.F.Simmons, J.S.Robertson, Differential Equations with Applications and Historical Notes, 2nd Ed., McGraw-Hill, Inc., New York, 1991.
6. Schaum's outline series, McGRAW-HILL, New York, 1991.

ECTS credits: **5.5 ECTS credits**

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

Examination methods:

The final examination consists of the written and the oral part. Students can take the final examination after the completion of lectures and exercises.

Course assessment:

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

P202	**Fundamentals of Electrical Engineering II**

Lecturer: Zdravko Valter, PhD, Full Professor

Course description:

Currents changing in time. Alternating and sinusoidal currents. Basic effects of alternating currents. Average and RMS values. Connecting R, L and C on an AC voltage. Power and voltage relations in AC circuits. Phasor representation. Impedance and admittance, complex power. Methods for solving electrical networks: direct usage of the Kirchhoffov' laws, the method of node voltages, the method of loop currents, the method of superposition. Thevenin's theorem, Norton's theorem and Millman's theorem. Compensation of the reactive power. Resonance. Q factor and frequency characteristic. Multiphase currents. Three-phase system. Delta and wye connected load. Power of the three-phase system. Inductances and transformer. Total inductance of mutual coils. Coreless transformer - equation and scheme. Transformer with iron core.

Knowledge and skills acquired:

Student will acquire knowledge of phasors, linear DC and AC circuits solving, complex power calculation; calculation of the compensation and resonance; current, voltage and power calculation in three-phase networks; as well as basic knowledge of tranformers.

Teaching methods:

Students are obliged to attend both lectures and exercises.

Student assessment:

Testing labaratory exercises, written and oral examinations

Obligatory literature:

1. B. Kuzmanović, Osnove elektrotehnike II, Element, Zagreb, 2000.
2. Felja, Koračin, Malić, Zbirka zadataka i riješenih primjera iz Osnova elektrotehnike, I. i II. dio, 1991.

Recommended additional literature:

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

ECTS credits: **7 ECTS credits**

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

Examination methods:

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

Course assessment:

Students' evaluation, analysis of their work in laboratory and grades scored in the written and the oral examination.

P203	Physics II
Lecturer:	Josip Brana, PhD, Assistant Professor
Course description: Gauss's law; Faraday's law; Ampere's law; Maxwell equations; electromagnetic field; energy of electromagnetic field; wave equation; Poynting vector; reflection; refraction; dispersion; absorption; geometrical optic; interference; Fraunhofer diffraction; polarisation; photo-metrics; black body radiation; Planck's law of radiation; photoelectric effect; Compton's effect; Rutherford and Bohr model of the atom; correspondence principle; dual nature of matter; electron diffraction; quantum numbers; spin; structure of atomic nucleus; radioactivity; fission; fusion.	
Knowledge and skills acquired: Students must acquire knowledge of concepts and mathematically formulated laws of electromagnetics, which enables them to understand electromagnetic phenomena in nature and technology as well as to solve simple problems.	
Teaching methods: Lectures, problem solving, laboratory practice.	
Student assessment: Laboratory test, written and oral examination.	
Obligatory literature: 1. Valovi i optika, P. Kulišić i V. Henč-Bartolić; 2. Riješeni zadaci iz valova i optike, V. Henč-Bartolić i dr.	
Recommended additional literature: 1. The Feynman Lectures on Physics, R. P. Feynman, R. B. Leighton, M. Sands; The Berkeley Physics Course.	
ECTS credits: **5.5 ECTS credits** An ECTS credit value has been added according to calculation of time required for studying and successful course completion.	
Examination methods: The final examination consists of the written and the oral part. Students can take the final examination after the completion of lectures and exercises.	
Course assessment: Conducting an anonymous questionnaire filled in by students after course completion. Permanent contact with students.	

P204	Electronics I
Lecturer:	Tomislav Švedek, PhD, Full Professor
Course description: Basics of semiconductor physics. Charge carrier generation. Current flow mechanisms in semiconductor. PN and metal-semiconductor junctions: static and dynamic characteristics. Solid-state diodes: static and dynamic characteristics, types of solid-state diodes. Bipolar junction transistor (BT): working principle, static IU-characteristics, dynamic models, frequency dependence of parameters. Junction and MOS FET: working principle, static IU- characteristics, dynamic models, frequency dependence of parameters. Thyristors: working principle, classification. Basic bipolar and unipolar transistor amplifiers. Power amplifiers: A, AB and B-class. Operational amplifier. Comparators. Basic logic circuits.	
Knowledge and skills acquired: - basic knowledge of semiconductor components, physical and electronics circuits - skills for analysis of semiconductor components and their adequate application in circuits	
Teaching methods: Lectures, problem solving, laboratory practice.	
Student assessment: Control tests, control of preparation for laboratory practice.	
Obligatory literature: 1. Švedek, Poluvodičke komponente i osnovni sklopovi, Svezak I, Poluvodičke komponente, Graphis, Zagreb, 2001.	

2. P.Biljanović, Elektronički sklopovi, Školska knjiga, Zagreb, 1989.

Recommended additional literature:

1. A.S.Sedra, K.C.Smith, Microelectronic Circuits, 3rd Edition, Saunders College Publishing, New York, 1991.

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

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

Course assessment:
Examination, tests, discussion.

P205	**Programming II**
Lecturer:	Davor Antonić, PhD, Associate Professor

Course description:
Revision of C programming language basic elements. Complex data types: arrays, structures, unions. Pointers: relation to arrays, pointer arithmetics. Functions. Parameter passing by value and by reference. Files: binary, ASCII, sequential, random access. Software development principles, top-down and bottom-up approach. Algorithm, transformation into program code. Examples of searching and sorting algorithms. Basics of object-oriented programming. Class and object. Inheritance.

Knowledge and skills acquired:
Systematic approach to software development. Detail knowledge of C programming language. Basics of object-oriented programming.

Teaching methods:

Lectures, laboratory practice.

Student assessment:
Laboratory practice evaluation, tests.

Obligatory literature:

1. Fischer, Zbirka zadataka iz C-a, ETF Osijek, 1999.
2. Motik, Šribar, Demistificirani C++ (2. izd.), Element, Zagreb, 2003.

Recommended additional literature:

1. Kernighan, Ritchie, The C Programming Language, Prentice-Hall, Englewood Cliffs, NJ, 1996.
2. Knuth, The Art of Computer Programming, Vol. 1., Fundamental Algorithms, Addison-Wesley, Reading, MA, 1997.

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

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

Course assessment:
Conducting an anonymous questionnaire filled in by students after course completion.

PF101	**English II** – optional
Lecturer:	Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Senior Lecturer

Course description:
Directions, personal data, opinion, places, position, expressing politeness, participation in longer conversations.

Knowledge and skills acquired:
Basic communicative patterns aimed at acquiring basic language structures.

Teaching methods: Lectures and language practice.
Student assessment: Written and oral assessment.
Obligatory literature: 1. The New Cambridge English Course, Book 1
Recommended additional literature: 1. Student's Book 2. Practice Book
ECTS credits: **0 ECTS credits** This course is optional and does not carry any ECTS credits.
Examination methods: Written and oral examination.
Course assessment: Students' evaluation at the course end.

Semester 3

P301	**Calculus III**
Lecturer:	Tomislav Marošević, PhD, Associate Professor
Course description: Real functions of several real variables. Level curves and level surfaces. Limits and continuity. Partial derivatives and differential. Equation of tangent plane to a surface. Partial derivatives of composite functions and implicit functions. Partial derivatives and differentials of higher orders. Taylor's formula for functions of several variables. Extrema and conditional extrema of functions of several variables. Double and triple integrals - basic concepts, calculation and applications. Line integrals (of the first and of the second kind) – definition, properties, calculation and applications. Vector functions of several variables. Scalar and vector field. Gradient of a scalar field; divergence of a vector field; curl of a vector field; applications. Complex functions of a complex variable. Derivative. Cauchy-Riemann equations. Integral of function of a complex variable. Cauchy theorem and integral formula. Taylor and Laurent series. Singularities. Residues.	
Knowledge and skills acquired: Students are introduced at the introductory level to basic ideas and methods of functions of several variables and functions of a complex variable, as a basis for other courses. Stress will be put on applications, and basic concepts are going to be analysed in an informal way. During exercises students should acquire certain techniques and be trained for solving concrete problems.	
Teaching methods: Students are obliged to attend both lectures and exercises.	
Student assessment: During the semester students can take several tests which replace the written examination. This ensures continuous assessment of students' work and knowledge.	
Obligatory literature: 1. P. Javor, Matematička analiza II, Element, Zagreb, 2000. 2. H. Kraljević, S. Kurepa, Matematička analiza 4/1 (funkcija kompleksne varijable), Tehnička knjiga, Zagreb, 1986.	
Recommended additional literature: 1. M. Krasnov et al., Mathematical Analysis for Engineers – Vol. 1, & ibid. Vol. 2, Mir Publishers, Moscow, 1990. 2. S. Kurepa, Matematička analiza 3 (funkcije više varijabli), Tehnička knjiga, Zagreb, 1979. 3. B.P. Demidovič, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke, Tehnička knjiga, Zagreb, 1986. 4. R. Galić, Funkcije kompleksne varijable – za studente tehničkih fakulteta, Osijek, Elektrotehnički fakultet, 1994.	

5. N. Elezović, D. Petrizio, Funkcije kompleksne varijable: zbirka zadataka, Element, Zagreb, 1994.

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

Examination methods:
The final examination consists of the written and the oral part. Students can take the final examination after the completion of lectures and exercises. During the semester students can take several tests which replace the written examination.

Course assessment:
During the semester students can take several tests which enables continuous assessment and stimulation of students' work. At the semester end an official questionnaire can be conducted pertaining to students' evaluation of course teaching and lecturers participating in course teaching.

P302	Fundamentals of Power Engineering and Ecology

Lecturer: Damir Šljivac PhD, Assistant Professor

Course description:
The importance of energy. Forms, sources and classification of energy. Non-renewable sources of energy (coal, oil, nuclear and geothermal energy). Renewable sources of energy (hydropower, biomass, wind power, solar energy etc.). Fundamental energy conversion. Conversion of primary energy forms into the final desired forms (conversion of chemical and nuclear energy into internal energy, internal energy into mechanical energy, potential water energy into mechanical energy, mechanical energy into electrical energy, direct conversions into electrical energy, conversion of electrical energy into other forms). Transmission energy. Transmission and distribution of energy forms. Storage of energy. Environmental impact of engineering products and processes. Industrial ecology. Life cycle assessment. Material flow analysis. Sustainable production and consumption systems.

Knowledge and skills acquired:
Getting acquainted with the basic knowledge of power engineering and ecology.

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

Student assessment:
Two control tests during the semester.

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

Recommended additional literature:
1. D. Feretić i suradnici: Elektrane i okoliš, Element, Zagreb, 2000.
2. V. Knapp: Novi izvori energije - nuklearna energija fisije i fuzije, Školska knjiga, 1993.
3. P. Kulišić: Novi izvori energije – sunčana energija i energija vjetra, Školska knjiga, 1991.

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

Examination methods:
Written and oral examination.

Course assessment:
Poll. Interviews and tutorials with students.

PEK301	Measurement Basics

Lecturer: Zdenko Godec, PhD, Full Professor

Course description:
Basic terms in metrology. Measurement uniformity, metrology pyramid, traceability. International system of (measurement) units (SI). Numerical (ratio) units. Errors. Measurement uncertainty. Complete measurement result. Decision making on the basis of complete measurement result. Types of signals, signal parameters, visualisation in

time and frequency domain. Measurement equipment. Measurement instruments (electromechanical, analog electronic, digital). Maintenance of measurement instruments. Digital multimetre. Oscilloscope. Digital measurement systems (sensor, transducer, conditioner, display). Noise, interference, minimising interference. Instrument transformers. Measurement methods (deflection, null, comparison, substitution, differential, direct, indirect). Measurement of electrical dc quantities (voltage, current, resistance). Measurement of electrical ac quantities (current, voltage, frequency, phase displacement, apparent power, active power, reactive power, power factor, energy, resistance, inductance, capacitance, dissipation factor, impedance and admittance). Measurement of magnetic and electric fields. PC based measuring systems.

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

Teaching methods:
Lectures, exercises and laboratory practice.

Student assessment:
Preliminary, written and oral examination.

Obligatory literature:
1. Z. Godec, Iskazivanje mjernog rezultata, Graphis, Zagreb, 1995.
2. Z. Godec, D. Dorić, Osnove mjerenja, laboratorijske vježbe, Sveučilište u Osijeku, Elektrotehnički fakultet, Osijek, 2001.
3. Z. Godec, D. Dorić, Električka mjerenja s laboratorijskim vježbama, Sveučilište u Osijeku, Elektrotehnički fakultet, Osijek, 2000.

Recommended additional literature:
1. D. Vujević, B. Ferković, Osnove elektrotehničkih mjerenja I i II, Školska knjiga, Zagreb, 1996.
2. V. Bego, Mjerenja u elektrotehnici, Školska knjiga, Zagreb, 1990.
3. D. Karavidović, Električna mjerenja I i II, ETF Osijek, 1994.
4. Šantić, Elektronička instumentacija, Školska knjiga, 1993.
5. J. Božičević, Temelji automatike II, Školska knjiga, Zagreb, 1982.

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

Examination methods:
Written and oral examination.

Course assessment:
During semester students may take several tests, by means of which students' work is assessed and stimulated. At the semester end an official questionnaire can be conducted pertaining to students' evaluation of course teaching and lecturers participating in course teaching.

Elective module III-1

PE301	**Basics of Thermodynamics**
Lecturer:	Marinko Stojkov, PhD, Assitant Professor

Course description:
On course and energy. Classification of energy forms. Generation of electrical energy from internal energy. Fluid. Definition of thermodynamic systems. 1st main rule of themodynamics for closed and opened systems. Application to thermal plant subsystems. Ideal gas and ideal liquid. Laws of behaviour of (ideal) gas and liquid. Thermal plant (nuclear plant) processes. Circular process of closed and opened systems. Thermal containers. Thermal (energetic) efficiency. 2nd main rule of thermodynamics. Role and formulations. Entropy, definition of entropy. Derivation of exergy and losses. Exergic efficiency. Aggregation state transitions. Processes in steam and gas thermal plant. Energy relations in steam, gas and hydro turbines: power and energy equations. Heat transition. General concepts of heat transition: means of heat exchange. Heat conduction. Transition of heat by natural and forced convection. Heat emission. Heat passing.

Knowledge and skills acquired:

Understanding energy (power engineering) processes in power engineering and thus aquiring knowledge necessary for calculation and control of such processes.

Teaching methods:
Lectures and problem solving.

Student assessment:
Three control tasks during the semester.

Obligatory literature:
1. H. Požar: Osnove energetike 1, Školska knjiga, Zagreb, 1992.
2. H. Požar: Osnove energetike 2, Školska knjiga, Zagreb, 1992.

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

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

Examination methods:
Oral and written examination.

Course assessment:
Discussion and tutorials with students. Survey. Control tasks.

PE302	**Electrical Materials**

Lecturer: Antun Pintarić, PhD, Associate Professor

Course description:
Structure of crystals, amorphous, liquid crystals, polymers, ceramics. Structure of metals and alloys. Materials properties and testing – mechanical, electrical, magnetic, thermal and manufacturing. Influence of structure on properties. Diffusion. Conducting materials – low-resistivity conducting materials, high-resistivity conducting materials, thermoelements, thermocouple, contacts, circuit breakers. Superconductors. Semiconductors. Magnetic materials – soft and hard magnetic materials. Ferrites. Materials for thermo-magneto-optic memory. Electrical insulating materials. Polarisation. Inorganic, organic and compound insulating materials. Influence of manufacturing processes on properties. Plastic deformation. Heat treatment. Powder metalurgy. Joint technologies and materials. Manufacturing semiconductors and integrated circuit. Materials selection.

Knowledge and skills acquired:
The proposed programme offers an undergraduate engineering student elementary knowledge of the structure and properties of engineering electrical materials. Understanding the relation between the structure and properties of materials and their selection and application in electrical engineering. This course is intended to prepare students for lifelong learning.

Teaching methods:
Lectures, laboratory practice, seminar.

Student assessment:
Seminar paper, final examination.

Obligatory literature:
1. W. D. Callister, Materials science and engineering: an introduction, John Wiley & Sons, New York, 2000.V.
2. Knapp, P. Colić, Uvod u električna i magnetska svojstva materijala, Školska knjiga Zagreb, 1990.
3. Solymar, L. Walsh, D.Electrical Properties of Materials, OUP, 1998

Recommended additional literature:
1. R. M. Brick i dr., Structure and Properties of Engineering Materials, McGraw Hill, 1977.
2. T. Filetin: Materijali i tehnologijski razvoj, Akademija tehničkih znanosti Hrvatske, Zagreb, 2002.

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

Examination methods: Final examination.
Course assessment: Examination analysis.

Elective module III-2

PK301	Electronics II
Lecturer:	Tomislav Švedek, PhD, Full Professor
Course description: Basics of electronic circuit analysis. Single-stage bipolar and unipolar transistor amplifiers. Setting and stabilization of biasing point. Analysis of dynamic parameters in small signal and at low frequencies: current and voltage gain, input and output resistance. Large signal mode of operation. Power amplifiers: A, AB, B, C and D class. Multi-stage amplifiers - cascading. DC coupled amplifiers: Darlington connection, cascode, differential amplifier, phase splitter. Feedback. Amplifier frequency characteristic and stability in presence of negative feedback. Operational amplifier. Impulse response and linear shaping. Comparators – comparator with hysteresis (Schmitt's trigger). Wave-shape generators: oscillators and multivibrators. Transistor as a switch. Analogue switch. Basic logic circuits, basic combinational and sequential circuits. Circuits of digital/analogue (D/A) and analogue/digital (A/D) conversion.	
Knowledge and skills acquired: Knowledge of electronic circuits analysis procedures in large and small signal mode of operation. Skills of analogue and basic digital circuits analysis. Skills of basic analogue and digital circuits design	
Teaching methods: Lectures, problem solving, laboratory practice.	
Student assessment: Control tests, students are controlled whether they have prepared for laboratory practice.	
Obligatory literature: 1. P.Biljanović, Elektronički sklopovi, Školska knjiga, Zagreb, 1991. 2. T. Švedek, Poluvodičke komponente i osnovni sklopovi, Svezak I, Poluvodičke komponente, Graphis, Zagreb, 2001 (udžbenik Sveučilišta J.J.Strossmayer u Osijeku)	
Recommended additional literature: 1. A.S.Sedra, K.C.Smith, Microelectronic Circuits, 3rd Edition, Saunders College Publishing, New York, 1991	
ECTS credits: **6 ECTS credits** An ECTS credit value has been added according to calculation of time required for studying and successful course completion.	
Examination methods: The final examination consists of the written and the oral part. Students can take the final examination after the completion of lectures and exercises.	
Course assessment: examination, tests, discussion	

PRK301	Digital Electronics
Lecturer:	Željko Hocenski, PhD, Full Professor
Course description: Digital circuits and systems features. Development survey. Number systems and conversions. Digital arithmetics. Codes. Error detection and correction codes. Logic functions. Logic function simplification. Logic integrated circuits. Characteristics of TTL, CMOS and modern technologies. Combination circuits: Analysis and Synthesis. Integrated logic circuit examples. Sequential circuits. State diagram. Flip-flop types and realisation. Asynchronous and synchronous counters. Synchronous counters design. Register types. Memories. Semiconductor memories: Bipolar and MOS. Static and dynamic RAM memories. ROM, PROM, EPROM, EEPROM memories. Memories programming. Magnetic media. Optic media. Programmable logic circuits: features, programming and applications. Visual displays. ADC and DAC circuits. Digital circuits and systems design software tools. Development and testing of digital circuits and equipment. Digital circuits' reliability.	

Knowledge and skills acquired:
Using lectures and individual work, student acquires basic knowledge in the field of digital integrated circuits and systems area, reasons of appearance, historical development, technological characteristics and production specifications. Logic functions, logic circuits, integrated logic circuits and simple applications in digital equipment and digital computers are presented. Student learns to recognize specific digital electronic problems and solving methods by using requirements specification in digital circuits and systems design. The skills in applying modern software tools for drawing logic diagrams, simulation and verification of logic circuits and systems are obtained. Design methods for logic circuits and structures by using integrated logic circuits, programmable logic circuits and microprocessor systems. Tools and instruments for development and diagnostic as logic probes, digital oscilloscopes, PAL and GAL programming tools, logic analysers, software tools for digital design (like MicroSim, OrCAD, Cadence etc).

Teaching methods:

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

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

Obligatory literature:

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

Recommended additional literature:

1. D.C.Green, Digital electronics, Addison Wesley Longman, 1999.
2. J.M.Yarbrough, Digital Logic, Applications and Design, West Publishing Company, 1997.
3. R.L.Tokheim, Digital Principles, McGraw-Hill, 1988.
4. J.F.Wakerly, Digital design, Principle and Practices, Prentice Hall, 1994

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

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

Course assessment:
Lecture attendance, exercises and examinations during the semester.

Semester 4

P401	Communication Networks

Lecturer: Drago Žagar, PhD, Associate Professor

Course description:
Communication network definition. Communication efficiency. Information and traffic network characteristics. Network flows and capacities. Communication network model. The project network parameters. Communication networks applications. Telecommunication network. The integrated digital communication network. Intelligent network. Network signalisation. The physical network structure. The logical network structure. OSI reference model. TCP/IP reference model. Transmission media. Wireless communication. Mobile networks, Local area networks. Industrial LANs and protocols. Telemetric networks and technologies. Ad Hoc networks. Internet network architecture. Network routing. Communication networks examples. Network services. Quality of service. Network security. Network standardisation.

Knowledge and skills acquired:

Students will acquire the basic knowledge of communication networks, how to design network parameters for specific applications, and to determinate the network traffic characteristics.

Teaching methods:

Lectures, exercises, laboratory practice. In addition to classical learning methods, advanced learning methods will be used.

Student assessment:

Several tests during the semester, knowledge examination of laboratory practice, written and oral examination.

Obligatory literature:

1. Bažant, et.al., Osnovne arhitekture mreža, Element Zagreb, 2003.
2. V. Sinković, Informacijske mreže, Školska knjiga Zagreb, 1994.

Recommended additional literature:

1. A.S. Tanenbaum, Computer Networks , Fourth Edition, Prentice Hall, 2003.

ECTS credits: **6 ECTS credits**

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

Examination methods:

Written and oral examination.

Course assessment:

Students' examination by the end of the course.

P402	**Probability and Statistics**

Lecturer: Radoslav Galić, PhD, Full Professor

Course description:

Fundamentals of combinatorics. Algebra of events. Probability and properties. Random variable. Distribution function of a random variable. Discrete and continuous probability distributions (hypergeometric, binominal, Poisson, normal, uniform, exponential, Chi-squared, Student`s distribution). Numerical characteristic of distribution. Two-dimensional probability distributions. Moments and correlations. Statistical set with parameters. Empirical and two-dimensional distributions. Correlation and regression analysis. Samples and numerical characteristic of samples. Parameter estimation. Interval estimation. Statistical hypothesis testing. Examples of statistical models, statistical thinking and application of statistical programmes. Writing a seminar paper.

Knowledge and skills acquired:

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

Teaching methods:

Students are obliged to attend both lectures and exercises.

Student assessment:

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

Obligatory literature:

1. R. Galić, Vjerojatnost , ETF, Osijek, 2004
2. R: Galić, Statistika, ETF, Osijek, 2004

Recommended additional literature:

1. Pavlić, Statistička teorija i primjena, Tehnička knjiga,Zagreb, 2000
2. Ž. Pauše, Uvod u matematičku statistiku, Školska knjiga, Zagreb, 1995.
3. Ž. Pauše, Vjerojatnost i stohastički procesi, Školska knjiga, Zagreb, 2004
4. G. M. Clarke, D. Cooke, A Basic Course in Statistics, Arnold, London, 1992.

ECTS credits: **5.5 ECTS credits**

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

Examination methods:

The final examination consists of the written and the oral part. Students can take the final examination after the

completion of lectures and exercises.

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

P403	Signals and Systems

Lecturer: Hrvoje babić, PhD, Full Professor

Course description:
Mathematical models of time-continuous and time-discrete signals and systems. Classification. Analysis of linear systems. Fourier transforms of time-continuous and time-discrete signals (FS, FT, DTFT and DTFS). Frequency characteristics and filtering principles. Laplace and Z-transform. Decomposition and realisation of systems. Stability, controllability and observability of systems. Signal sampling and regeneration. Equivalence of time-continuous and time-discrete systems. Software used for analysis and simulation of systems.

Knowledge and skills acquired:
Students acquire knowledge necessary for analysis and modelling signals and systems.

Teaching methods:
Lectures, problem solving and laboratory practice.

Student assessment:
Control tests and tests in laboratory practice.

Obligatory literature:
1. H.Babić. Signali i sustavi. Zavodska skripta, ZESOI, Fakultet elektrotehnike i računarstva Zagreb, 1996.

Recommended additional literature:
1. A.V.Oppenheim, A.S.Willsky. Signale und Systeme, Arbeitsheft, VCH, Verlagsgesellschaft, Weinheim, 1989.
2. Gabel i Roberts: Signals and Linear Systems, 3/e, J. Willey, 1987.

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

Examination methods:
Written and oral examination.

Course assessment:
Students' questionnaire.

PEK401	Network Analysis

Lecturer: Ivan Flegar, PhD, Full Professor

Course description:
Kirchhoff networks. Basic properties of dissipative elements.One-port and multiport resistors.Basic properties of reactive elements. Commutation laws.Conservation of charge in the node. Conservation of flux in the loop.Time responses of networks. First-and second-order circuits.Fundamentals of network topology. Network matrices.Node and mesh analysis.Loop and cut-set analysis.State equations. Computer aided analysis of networks. Superposition integrals.General method of analysis of linear-time invariant networks.Network functions.Network theorems. Two-port equations. Distributed parameter network.Differential equations for the uniform line.Harmonic steady-state solution. Particular cases: the line with no reflection, distortionless line, lossless line.

Knowledge and skills acquired:
Acquisition of knowledge in the time-domain and the frequency-domain analysis of electrical networks. It is a prerequisite for the comprehension of networks designed for a special purpose (pulse circuits, filters, power circuits etc.).

Teaching methods:
Lectures, problem solving and laboratory practice.

Student assessment:
Preliminary examinations, tests, examination.

Obligatory literature:

1. I.Flegar,Teorija mreža, Sveučilište u Osijeku, Osijek 2001
2. I.Flegar, Teorija mreža-Zbirka zadataka, Sveučilište u Osijeku, Osijek 1997.

Recommended additional literature:

1. L.O.Chua, C.A.Desoer, E.S.Kuh, Linear and nonlinear circuits, Mc Graw Hill Comp., New York, 1987.
2. J.W.Nilsson, S.A Riedel, Electric circuits, Reading, Massachusetts, Addison-Wesley Publ. Comp., 1996.

ECTS credits: **5.5 ECTS credits**

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

Examination methods:

Written and oral examination.

Course assessment:

Partial examinations.

P404	**English I**

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

Course description:

Introduction to mathematics. Basic concepts in physics. The atom. Interaction in atomic systems. Conducting and insulating materials in electrical engineering. Magnetic materials and electromagnetism. Some basic notions concerning energy, electromotive force and power.

Knowledge and skills acquired:

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

Teaching methods:

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

Student assessment:

Individual homework or group task projects, regular communication, exercises, written and oral examination.

Obligatory literature:

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

Recommended additional literature:

1. Ferčec, I. *A Course in Scientific English: Mathematics, Physics, Computer Science*, Odjel za matematiku/Elektrotehnički fakultet, Osijek, 2001.
2. R.Murphy, *English Grammar in Use*, CUP, Cambridge, 1995.

ECTS credits: **2 ECTS credits**

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

Examination methods:

Written and oral examination.

Course assessment:

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

Elective module IV-1

PE401	Fundamentals of Electrical Machines
Lecturer:	Zdravko Valter, PhD, Full Professor
Course description: Fundamentals of energy transformation. Transformers. Ideal and real transformer. Kapp's diagram. Losses and usefulness. Three-phase transformers. Autotransformer. Measuring transformers. Transformer performances. Rotary machines and their models. Current lining and flow. DC machines. Induced voltage and developed torque. Mode of operation and performances. AC machines. Induced voltage and developed torque. Mode of operation of synchronous and asynchronous machines. Their performances. One-phase machines.	
Knowledge and skills acquired: Knowledge of theoretical fundamentals, performances and modes of operation for electrical machines. Capability to differentiate between the properties of electrical machines and their concrete application.	
Teaching methods: Lectures, calculations and laboratory practice	
Student assessment: Writing laboratory reports.	
Obligatory literature: 1. Valter, Z.: Električni strojevi I i II, interna skripta ETF Osijek, 2004/05. 2. Wolf, R.: Osnove električnih strojeva, Školska knjiga, Zagreb 1991. 3. Dolenc, A. i dr.: Električni strojevi, TE/4 JLZ, Zagreb 1973. 4. Kelemen, T.: Transformator, TE/13 HLZ, Zagreb 1997.	
Recommended additional literature: 1. Piotrovskij, L.M.: Električni strojevi, Tehnička knjiga, Zagreb 1970. 2. Dolenc, A. i dr.: Transformatori I i II, skripta ETF Zagreb, 1978. 3. Bego, V.: Mjerni transformatori, TE/8 JLZ, Zagreb 1982.	
ECTS credits: **5.5 ECTS credits** An ECTS credit value has been added according to calculation of time required for studying and successful course completion.	
Examination methods: Test and oral examination.	
Course assessment: Conducting an anonymous questionnaire filled in by students after course completion.	

Elective module IV-2

PRK401	Information Theory
Lecturer:	Franjo Jović, PhD, Full Professor
Course description: Nature of the information. Information sources and users. Events and information. Information layers: stochastic, syntax, semantic, pragmatic, apobetic. Information redundancy. Entropy. Entropy on the information channel. Codes. Markov chains. Syntactic aspect of the information: rules and syntax forms. Semantic parameters: actuality, existence, reachability, relevance and importance. Measurement of the semantic information aspect: SIT. Natural languages. Bioinformatics. Signal and information: BT. Analytic and asymptotic signals. Noise and information channel coding: Shannon's theorem. Bayes' postulate and theorem. Optimum code. Coding time. Complex data processing: selection, filtering, classification and presentation. Qualitative and quantitative information aspects. Železnikar's theses. Information agents: independent, team and social. Information agent construction. Web agents	
Knowledge and skills acquired: Determination of the source information. Coding and information transmission. Information source evaluation. Information processing. Construction of information agents.	
Teaching methods:	

Lectures and laboratory practice are mandatory.

Student assessment:
Test examples from problem solving, oral examination.

Obligatory literature:
1. Ž. Pauše: Uvod u teoriju informacije, Školska knjiga, Zagreb, 1989.
2. V. Matković i V. Sinković: Teorija informacije, Školska knjiga Zagreb, 1984.

Recommended additional literature:
1. R.W. Hamming: Coding and Information Theory, Prentice Hall, Englewood Cliffs, N.J: 1982.
2. F. Jović: Skripta iz informacijske tehnike, http//:etfos/LAI

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

Examination methods:
Test and oral examination.

Course assessment:
Students will be asked to participate in the evaluation of the course acceptance during and at the end of the course. Lecturers that consider this course mandatory are also invited to give their assessment.

Semester 5

P503	**English II**
Lecturer:	Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Lecturer

Course description:
Characteristics of capacitance. Lenz's law – inductance. Ohm's law – resistance. The A-C cycle. Electric quantities and units – definitions. Introduction to electronics and power engineering. Recycling. Environmental protection. Ecology.

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

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

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

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

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

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

Examination methods:
Written and oral examination.

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

Elective module V-1

PE501	Fundamentals of Electric Drives
Lecturer:	Zdravko Valter, PhD, Full Professor
Course description: Tasks and structure of electric drives. Speed-torque characteristics of industrial equipments and electrical motors. Static and dynamic behaviour of electric drives. Drives with DC motors. Variable voltage supply for DC motors. Drives with asynchronous and synchronous motors. Converter for AC motors. Dynamic of electric drives. Choice of driver motor. Modelling and simulating electric drives.	
Knowledge and skills acquired: Knowledge of drive kinds, their properties and characteristics. Capability to calculate and choose a drive system for concrete application.	
Teaching methods: Lectures, calculations and laboratory practice	
Student assessment: Writing laboratory reports.	
Obligatory literature: 1. Valter, Z.: Elektromotorni pogoni, interna skripta ETF Osijek, 2005. 2. Jurković, B.: Elektromotorni pogoni, Školska knjiga, Zagreb, 1990. 3. Grupa autora: Elektromotorni pogoni, TE/4 JLZ, Zagreb, 1973.	
Recommended additional literature: 1. Riefenstahl, U.: Elektrische Antriebstechnik, Teubner Verlag, Stuttgart Leipzig, 2000. 2. Vogel, J.: Elektrische Antriebstechnik, Hütig Verlag, Heidelberg, 1998.	
ECTS credits:	**7 ECTS credits** An ECTS credit value has been added according to calculation of time required for studying and successful course completion.
Examination methods: Test and oral examination.	
Course assessment: Conducting an anonymous questionnaire filled in by students after course completion.	

PE502	Electric Power Networks
Lecturer:	Lajos Jozsa, PhD, Associate Professor
Course description: Introduction: Electric power networks and their parts. Types, purpose and operation of the power systems. Three phase system in calculation: Electrical quantities of power system elements. Active and passive network-branches. Symbolic representation of the power. Power flow in system-elements. Symmetrical components. Transmission theory: Transmission line equations. Ideal transmission line (lossless transmission line). Real transmission line. Transmission line constants: Line resistance. Line inductance. Impedance-matrix of the line. Line shunt conductance. Line capacitance. Admittance-matrix of the line. Equivalent schemes of power system elements. Equivalent schemes for transmission lines. Equivalent schemes for transformers. Equivalent schemes. for generators. Equivalent schemes for loads. Four terminal network-elements in transmission line theory. Power system calculations: Numerical quantities in power system calculation. Absolute value method. Per-unit method.	
Knowledge and skills acquired: Getting acquainted with the physical basics of the elements of power system, as well as with the entire network. Getting acquainted with the mathematical and graphical models of elements and the entire network.	
Teaching methods: Lectures, problem solving and laboratory practice.	
Student assessment: Written problem solving tests, oral laboratory practice tests, examination.	
Obligatory literature:	

1. M. i K. Ožegović, Električne mreže I, i II – udžbenik, FESB Split, 1996
2. S. Nikolovski, Elektroenergetske mreže - zbirka riješenih zadataka, Elektrotehnički fakultet Osijek, 2003.
3. L. Jozsa, Jedinične konstante nadzemnih vodova, interna skripta, Elektrotehnički fakultet Osijek, 2004

Recommended additional literature:

1. B. Stafanini, Prijenos električne energije, skripta FER Zagreb
2. D. Elgred, Electric Energy Systems Theory, Mc-Graw Hill, N.Y. 1983.

ECTS credits: **6 ECTS credits**

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

Examination methods:

Written and oral examination.

Course assessment:

At the end of the semester an official enquiry can be conducted concerning students` evaluation of the course lectures and lecturers participating in the course teaching.

PEK401	**Principles of Power Electronics**

Lecturer: Ivan Flegar, PhD, Full Professor

Course description:

Power converters.Basic concepts.Basic properties.Power indices of conversion process.Conversion device concept.Constitutive devices and topology of power converters. Possible u-i characteristics of conversion devices.Uncontrolled switch. Unilateral current, unilateral voltage and bilateral switches. Realization of conversion devices comprising two or more power semiconductor devices.Dc converters.Basic properties.One-quadrant direct and indirect dc converters. Two-and four -quadrant dc converters.Reduction of power semiconductor devices switch stresses. Rectifiers.Basic properties.Uncontrolled rectifiers.Phase-controlled rectifiers. Rectifier and inverter mode of operation. Autonomous inverters. Basic properties.Resonant inverters.Series and parallel inverters.

Knowledge and skills acquired:

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

Teaching methods:

Lectures, problem solving and laboratory practice.

Student assessment:

Preliminary examination, tests, examination.

Obligatory literature:

1. I.Flegar. Sklopovi energetske elektronike, Graphis, Zagreb, 1996.
2. D.Slišković, I.Flegar: Energetska elektronika-Laboratorijske vježbe, Graphis,Zagreb,1996.

Recommended additional literature:

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

ECTS credits: **7 ECTS credits**

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

Examination methods:

Written and oral examination.

Course assessment:

Partial examinations.

PER501	**Basics of Automatic Control**

Lecturer: Dražen Slišković, PhD, Assistant Professor

Course description:

Automatic control and its purpose. Basic terms and definitions. Basic structure and elements of the control loop. Implementation of a control system. Properties of controlled systems. Linearization of characteristic curve. Dynamic behaviour of the system and its mathematical description. Description of linear, continuous and time invariant systems in time and frequency domain. Laplace transform and transfer function. Bode and Nyquist plot. Basic dynamic elements. Control loop and its characteristics. Control loop stability and methods of stability analysis. Performance indices in time and frequency domain. Basic controller types. Control loop synthesis. Fixed set-point control and servo control. Control loop behaviour in regard to reference variable and disturbance. Classic methods of synthesis of linear continuous control systems. Synthesis in time and frequency domain. Empirical rules for setting the controller parameters. Improvement of dynamic properties of control systems by introducing feedforward and cascade control. Practical examples. Principles of digital implementation of control systems.

Knowledge and skills acquired:
This course of study gives the basics of description of system dynamic behaviour, structural presentation of the basic elements and systems of automatic control, feedback phenomenon in the system, and feedback system stability analysis. Additionaly, the students acquire basic knowledge about control algorithm design and how to evaluate the achieved control quality. In laboratory practice they gain skills in using basic software tools for control system analysis and synthesis (Matlab), and learn about the methodology of practical control system implementation.

Teaching methods:

Lectures, seminars and laboratory practice.

Student assessment:
Laboratory practice tests, written tests during the semester and the final examination.

Obligatory literature:

1. Perić, N.: Automatsko upravljanje - predavanja, Zavodska skripta, FER, Zagreb, 1998.

Recommended additional literature:

1. Tomac, J.: Osnove automatske regulacije - predavanja, Fakultetska skripta, ETF, Osijek, 2004.
2. Šurina, T.: Automatska regulacija, Školska knjiga, Zagreb, 1991.
3. Franklin, G.F., J.D. Powell, A.E. Naeini: Feedback Control of Dynamic Systems, Addison - Wesley Publishing Company, 1994.

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

Examination methods:
Written and oral examination.

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

Elective module V-2

PRK501	**Data Bases**
Lecturer:	Ninoslav Slavek, PhD, Assistant Professor

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

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

Teaching methods:

Lectures are optional, laboratory practice is obligatory

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

Obligatory literature:

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

Recommended additional literature:

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

ECTS credits: **7 ECTS credits**

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

Examination methods:

Written and oral examination.

Course assessment:

At the end of the semester an official enquiry can be conducted concerning students` evaluation of the course lectures and lecturers participating in the course teaching

PRK502	Modelling and Simulation

Lecturer: Franjo Jović, PhD, Full Professor

Course description:

Model types. Process models. Physical limits of modelling – participation model. Mathematical models – anticipative and incursive models. Electrotechnical component models. Connectivity model. Approximative models and set theory. Qualitative and quantitative modelling. Software process models. Hydrodynamical models. Unit process models – laser processes. Bond graph modelling method. Scale models and analogies. Verbal models. Models and corresponding differential equations. Discretized solutions. Fluid dynamic models. Boundary and discretization conditions.

Knowledge and skills acquired:

System approach to model design. Skills of modern modelling tools application. Modelling in various technology fields. Design of various model types and basic simulation skills.

Teaching methods:

Lectures and laboratory practice are mandatory.

Student assessment:

Design of verbal model, design of laboratory models, oral examination.

Obligatory literature:

1. Monself Y.: Modelling and Siumulation of Coimplex Systems - Methods, Techniques aand Tools, SCS, European Publ. House, 1998.

Recommended additional literature:

1. Kramer/Neclau: Simulationstechnik, Springer Verlag, Wien, 1998.
2. Kuipers, B.: Qualitative reasoning, Modelling ans Simulation, MIT Press, 1999.
3. Jović F, Flegar I, Slavek N.: Modeliranje i simulacija, Skripta ETF Osijek, 2005.

ECTS credits: **6 ECTS credits**

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

Examination methods:

Test and oral examination.

Course assessment:

During and at the semester end students will be asked to evaluate the acceptability of the teaching methods. Course lecturers are asked to give their opinions as well.

PRK503	Computer Architecture

Lecturer: Željko Hocenski, PhD, Associate Professor

Course description:

Basic features of a digital computer. Microprocessor. 8-bit microprocessor architecture. System busses. Microcomputer operation: instruction fetch and execution. Instruction set. Addressing modes. Instruction execution time. Personal computer architecture. Intel microprocessor familiy. Address decoders and bus drivers. Motherboards and specific busses. Input-output functional units. Parallel input/output interface (PIO). Parallel busses and basic

protocols (AT/ISA, SCSI, PCI, GPIB). Serial interface (UART, SIO). Serial busses and protocols (RS-232, RS-485, USB, IEEE-1394, IIC). Timing circuits (CTC). Memory devices. Memory organisation: Cache and virtual memory. Memory management. External storage. Magnetic media (Floppy, HDD). Optical disks (CD-ROM, CD-R/W, DVD). Direct memory access (DMA). Basic input/output methods. Interrupts. Modern microprocessor and computer architecture. Selfdiagnostics. Reliability. Design and diagnostics tools and equipment.

Knowledge and skills acquired:
Using lectures and individual work a student acquires knowledge of computer architecture, microprocessor and microprocessor systems, technological characteristics and production specifications. Students learn how to recognise specific computer design problems and solving methods. Skills of applying modern software tools for hardware and software design, simulation and verification are obtained. Design methods for logic circuits and structures by using integrated logic circuits, programmable logic circuits and microprocessor systems. Tools and instruments for development and diagnostic as logic probes, digital oscilloscopes, PAL and GAL programming tools, logic analysers, software tools for digital design (such as MicroSim, OrCAD, Cadence etc).

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

Student assessment:
Solving simple individual problems and team work on more complex problems.
On-line testing using e-learning tools like WebCT with questions data base.
Assessment of laboratory work and estimation of design, construction, testing and presentation of students' own simple circuits and devices.
Discussion with a student to form the final grade.

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

Recommended additional literature:
1. S. Ribarić: Arhitektura računala, Školska knjiga, Zagreb, 1990
2. J.L. Hennessy, D.A. Patterson: Computer Architecture, A Quantitative Approach; Morgan Kaufmann Publishers, 1990.
3. V.P. Heuring, Harry F. Jordan,Computer Systems Design and Architecture, Addison-Wesley, 1997.

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

Examination methods:
Assessment of knowledge during lectures and individual problems solving and the oral examination.

Course assessment:
Attendance on lectures, exercises and examinations.

PK501	**Communication Systems**
Lecturer:	Snježana Rimac-Drlje, PhD, Associate Professor

Course description:
The communication channel model. Random processes, power spectral density; noise sources in communication systems, noise models. Principle of amplitude, frequency and phase modulation; analysis of the analogue systems (AM, FM, PM) and digital systems (ASK, FSK, PSK, QAM). Signal to noise ratio (S/N) and BER. Transmission media. Radio links. Mobile communication systems (GMS, UMTS). Satellite communication systems. Television broadcasting, cable TV. Optical communication systems: semiconductor laser diodes, optical amplifiers, optoelectronic modulators and photodetectors; multimode and single-mode optical fibers; operating windows, attenuation and dispersion of optical signal,dispersion compensation; wavelength division multiplexing. Integration

of the communication systems.

Knowledge and skills acquired:
Students will acquire fundamental knowledge of the communication channel modelling and knowledge of the modulation system analysis with respect to the spectral efficiency as well as the resistance to noise. They will be able to choose components of the communication system, to calculate the basic parameters of a radio link, an optical communication system and a cabel TV system. Students will acquire basic knowledge of the radiodiffusion system's parameters, as well as knowledge of the demands in the mobile radio-network design.

Teaching methods:
lecture (3 hours per week), problem solving (1 hour), laboratory practice (1 hour)

Student assessment:
Laboratory practice tests, written and oral examinations.

Obligatory literature:
1. E. Zentner, Antene i radiosustavi, Školska knjiga , Zagreb, 2001.
2. B. Zovko-Cihlar, Televizija u boji, Hrvatski leksikografski zavod Miroslav Krleža, 1992.
3. T. Brodić, G. Jurin, Svjetlovodna tehnika, Tehnički fakultet, Sveučilište u Rijeci, 1995.

Recommended additional literature:
1. M. J. Hernando, F. Perez-Fontan, Introduction to mobile communications engineering, Artech House, 1999.

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

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

Course assessment:
Students evaluation.

Semester 6

P601	**Company Economics**

Lecturer: Vlado Majstorović, PhD, Full Professor

Course description:
Introduction to company economics. Special characteristics of electrical-engineering companies.Production process and company means. Cost results and calculation. Calculation of investment operations. Business results and profitability analysis. Economics of business function.

Knowledge and skills acquired:
After the successful completion of the programme, students acquire knowledge of company economics,costs,effects,calculations and especially of business results and profitability factors.

Teaching methods:
Lectures and exercises.

Student assessment:
Control tests.

Obligatory literature:
1. Karić, M., Lacković, Z.,Ekonomika elektrotehničkih poduzeća, Elektrotehnički fakultet,Osijek,2003.

Recommended additional literature:
1. Karić, M.,Ekonomika poduzeća, Ekonomski fakultet,Osijek,2002.

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

Examination methods:
Oral examination after the successful completion of the programme assignment.

Course assessment:

Conducting an anonymous questionnaire filled in by students after course completion

P602	Technical System Designing
Lecturer:	Tomislav Mrčela, PhD, Associate Professor

Course description:
Introduction.Technical systems. Properties of technical systems. Developing technical systems. Technical systems division. Electrical systems. Design. Basic development theory. Creativity. Structure of process developing. Project types. Operations and activities in designing. Containment design process Integrated design access. Decision making. Knowledge-base and data-base. Knowledge resources. Data acquisition and preservation. The technical concept solutions.Catalogue of knowledge and skills. Optimal and alternative project solution.
Choice. Project standardization. Technical project standardization. Introduction of norms and standards into electro technical systems. Evaluation of projects in electrical engineering and introduction of regulatory rules about project realisation.

Knowledge and skills acquired:
During the course students acquire general knowledge of technical systems, they get acquainted with the norms and standards applied in the electro-technical systems as well as the introduction of regulatory rules about realisation of electro-technical projects.

Teaching methods:
Lectures, exercises and seminars.

Student assessment:
Two preliminary examinations during the semester.

Obligatory literature:
1. Božidar Križan, Osnove proračuna i oblikovanja konstrukcijskih elemenata, Sveučilište u Rijeci, Tehnički fakultet Rijeka, 1998.
2. Pahl G., Beitz W., Engineering Design – A Systematic Approach**,** Springer-Verlag, Berlin Heidelberg New York 1991.

Recommended additional literature:
1. Karlheinz Roth, Konstruieren mit Konstruktionskatalogen, Sprenger-Verlag Berlin Heidelberg New York 1982.
2. Hubka V., Eder E., Design Science – Introduction to the Needs, Scope and Organisation of Engineering Design Knowledge, Springer Verlag, Berlin Heidelberg New York 1995.

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

Examination methods:
Oral examination after the successful completion of the programme assignment.

Course assessment:
Conducting an anonymous questionnaire filled in by students after course completion.

P603	Communication Skills
Lecturer:	Antun Pintarić, PhD, Associate Professor

Course description:
Introduction to communication. Oral presentation. Memos and correspondence. Non-verbal communication. Team work and listening. Public speaking. Leading discussion groups and meetings. Business and professional communication. Managing conflict. Web publication. Presentations. Formal reports. Illustration. Ethics and engineering.

Knowledge and skills acquired:
Learning various components of effective communication to improve student's presentation skills.Learn and practice effective listening and communication skills, public speaking skills, how to run effective meetings, work in groups, etc. Motivate students to use the tools and techniques immediately for improving their communication.Developing a clear technical writing style. Collect,organise and evaluate information and data effectively.Use appropriate formats for professional documents; How to recognize ethical dimensions of engineering communication, research, and

practice.

Teaching methods:
Short lectures, exercises, tutorials, presentations

Student assessment:
Seminar paper, interactive communication tests

Obligatory literature:
1. M. Plenković: "Poslovna komunikologija", Alinea, Zagreb 1991.
2. A.Mattelart & M. Mattelart: Theories of Communication - A Short Introduction, Sage Publications, London, 1998.

Recommended additional literature:
1. M. Plenković: KOMUNIKOLOGIJA MASOVNIH MEDIJA, Barbat, Zagreb, 1993.
2. F. Vreg: "Humana komunikologija", HKD i Nonacom, Zagreb 1998.
3. J. Plenkovic: "Društvo i tehnologija" Građevinski fakultet Sveučilišta u Rijeci i HKD, Rijeka / Zagreb, 1998.

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

Examination methods:
All assessments will be carried out during the semester.

Course assessment:
Conducting an anonymous questionnaire filled in by students after course completion

P604	**English III**

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

Course description:
Introduction to computer science terminology. Computer applications. Configuration. Hardware vs. software. Memory. Buying a computer. Input devices. Output devices. Storage devices. Operating systems. The graphical user interface. Word processing facilities. Design. Multimedia systems. Electronic communications.

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

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

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

Obligatory literature:
1. Ferčec, I. *A Course in Scientific English: Mathematics, Physics, Computer Science*, Odjel za matematiku/Elektrotehnički fakultet, Osijek, 2001.

Recommended additional literature:
1. R.Murphy, *English Grammar in Use*, CUP, Cambridge, 1995.
2. Scientific and professional papers from the fields of computer science and communications.

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

Examination methods:
Written and oral examination.

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

P605	Final work
Lecturer:	
Course description: Within the final work (project) framework and under supervision of their tutors students will solve problems pertaining to their respective fields of study at the Bachelor level. By completing their projects sucessfully students will prove that they can apply knowledge acquired at the Faculty to practical work.	
Knowledge and skills acquired: Knowledge and skills necessary for independent work as engineers.	
Teaching methods: Permanent contact with tutors.	
Student assessment: Working under supervision of the tutor.	
ECTS credits: **10 ECTS credits** An ECTS credit value has been added according to calculation of time required for studying and successful course completion.	
Examination methods: Final presentation of the completed task.	
Course assessment: An anonymous questionnaire filled in by students after they complete their studies.	