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Second Cycle Degree in Computer Engineering (Master level) Study Programme

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CONTENTS

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.
Computer engineering studies programme profiles in the field of technical sciences which educates experts and potential young scientists for a very important field of technological and the overall social development**.** Present–day improvements in techniques and technology are just the result of thorough research and development in the field of electrical and computer engineering.

Assessment of rationale with respect to labour market requirements - The labour market in Croatia shows that experts who complete their Master programme in computer engineering get employed easily on different workplaces in almost every company, institution and institute. According to some facts obtained from the Croatian Employment Service, there are practically no unemployed experts in the field of computer engineering. This fact can be attributed to a rather rapid development and application of computers and computer networks as well as new services offered by the network. This trend is going to be continued which is the main reason for starting a study of this profile. Computer and communication industry is continuously undergoing a process of rapid expansion which has created the need for a great number of engineers of the above mentioned profile. Master level of computer engineering, bachelor level of computer engineering and the doctorate will make a logically encircled whole of education of engineers in the field of computer engineering. Engineers who successfully complete the Master level programme in computer engineering, MSc in Computer Engineering, will have skills and knowledge needed to confront complex research and development problems as well as application of new technologies. Further social and economic development of modern society as well as Croatia is inconceivable without computer engineering and telecommunications which are present in every segment of human life**.**
Today, computer engineering is and will be even more an interdisciplinary component connecting different scientific fields and will be the initiator of further development and progress of human race. Highly educated experts in computer 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 computer 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 computer and communications industry, which is supported by most recent ideas of the scientific field of electrical engineering. The initiator of the development and researches in this field is the labour market, which supports further investment into science and research in the field of computer 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. Continuous and first-rate scientific work carried out at the Faculty will ensure outgoing experts of high quality in the scientific field of computer engineering.

Comparability with programmes of other eminent foreign higher education institutions – The Master level of computer engineering at the Faculty of Electrical Engineering in Osijek is based on study programmes of other distinguished European universities. Furthermore, it can be compared with the Master level programme in computer engineering at TU Vienna. The common base is the study duration of two years during which students can acquire the minimum of 120 ECTS credits. The professional qualification awarded after the successful completion of second cycle studies is Master of Science in Computer Engineering, indicating the field of specialisation**.** Some advanced knowledge of fundamental course units of specific fields and elective modules/course units where students can acquire some additional knowledge of a specific field represent the basis for this study.

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 studies, which was accepted in 2003, engineers in the scientific field of electrical engineering are educated at the Faculty of Electrical Engineering. Students can choose one of the three following branches: Power Engineering**,** Automation and Computer Engineering in Process Control, and Computer Engineering and Telecommunications**.** Computer science interweaves with computer application in automation of industrial facilities through both branches**.** Furthermore**,** postgraduate studies programme in computer engineering is carried out at the Faculty of Electrical Engineering with the branch in Computer Engineering in Process Control**.** On account of the mentioned studies**,** the Faculty of Electrical Engineering has gained valuable experience in the education of experts in the scientific field of computer engineering. Former undergraduate programme in electrical engineering and postgraduate programme in computer engineering represent the foundation for the new First cycle study programme in computer engineering that will, together with the Second cycle and the Third cycle study programme**,** 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 computer engineering.

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

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

Electrical Engineering are Croatian National Grid Company (Hrvatska elektroprivreda), Croatian telecommunications (THT), VIPNet as well as other companies interested in the study of such profile.

d) Faculty overtness towards mobility of students

Within the scope of the Master level of computer engineering, students from other universities/faculties will be given an opportunity to study particular courses/modules or 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. Candidates that have completed the adequate degree at some other related technical and natural science faculties will be enabled to enrol in the Master level study programme of electrical engineering at the Faculty of Electrical Engineering in Osijek. A high level of students' mobility will be enabled in this way. 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*:

Second cycle degree in computer engineering.

2.2. *Institution*:

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

2.3. *Duration of study*:

Master level study programme in computer engineering would take **2 years** and a student should acquire a minimum of **120 ECTS credits**.

2.4. *Entry requirements*:

Prior to their enrolment in the second cycle degree (Master of Science) study programme in computer engineering applicants should successfully complete the first cycle degree (Bachelor of Science) study programme in electrical or computer engineering. It would also be possible for applicants who graduated from other corresponding engineering and natural science study programmes to enter the second cycle, taking a compulsory course unit or module enhancing fundamental courses in electrical and computer engineering indispensable to a successful continuation of the study programme, whereby first cycle courses would be acknowledged as electives. In this way a high level of student mobility within natural and engineering sciences would be obtained.

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

Upon graduation from the Faculty of Electrical Engineering in Osijek MSc degree holders in Computer Engineering would acquire knowledge and skills to carry out investigations, design, develop and apply various solutions in the field of computing relative to industry, the private and public sector, banking, transport, environment protection, etc. MSc in CE would learn how to identify, formulate, survey electronic and print literature and solve complex engineering tasks, whereby he/she would draw important conclusions applying first of all basic mathematical principles and engineering sciences. In addition, they would learn how to design solutions to complex engineering tasks, as well as systems, components and processes corresponding to specific demands, paying special attention to public health care, security, cultural and societal values, and environment protection. MSc degree holders in CE would be able to investigate complex problems, including experimental design, data analysis and interpretation, as well as synthesis of all information by creating effective judgement. Furthermore, they would be able to create, select and apply respective techniques, resources and modern engineering tools, including prediction and modelling, to complex engineering activities, understanding at the same time limits such tools might have.

Second cycle degree holders (MSc) in computer engineering, branch: Computer Engineering in Process Control, would acquire the necessary knowledge and abilities to:

- create, develop and maintain modern microprocessor and computer systems;
- develop and update system and application software for standard and specialised computer equipment;
- expand functional hardware and software capabilities of modern computer systems;
- develop, adapt and implement modern computer technologies in different fields of application;
- work efficiently, which involves problem identification, user requirements specification, computer system analysis, design and development, accompanied by appropriate engineering documentation.
- study principles of operation and mathematical description as well as construction and description of measuring, control, and other elements of automation systems;
- research, develop and apply the analysis resp. synthesis method of control systems, as well as methods of mathematical modelling, computer simulation, and optimisation of various systems;
- develop, design and apply hardware and software support for computer controlled engineering processes;
- develop, design, implement, test and maintain automated technological, power and transport plants, processes and facilities;
- apply methods for testing, documentation and evaluation of automation systems.

In addition to first cycle degree holders (BSc) in Computer Engineering who graduated from the Faculty of Electrical Engineering in Osijek, graduates from other first cycle degree granting institutions (universities, departments) in computer engineering would be able to enrol in the second cycle study programme in computer engineering (leading to an MSc degree). Furthermore, first cycle degree holders (BSc) in electrical engineering and other engineering and natural study programmes encompassing fundamental knowledge of mathematics, physics and computer engineering, would also be able to enrol in the MSc study programme. However, a special course module would be organised for such students, aiming at acquiring the knowledge necessary for their studies.

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

After the successful completion of the second cycle study programme (Master level) in computer engineering graduates would be awarded the title **Master of Science in Computer Engineering**, branch: **Computer Engineering in Process Control.**

3. Program Description

3.1. Second Cycle Degree Study Programme in Computer Engineering- branch: Computer Engineering in Process Control - obligatory and elective courses

Curriculum of the Second cycle degree study programme in Computer 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: D Bx y z

where: D – one-letter symbol for the second-cycle degree study programme
B – one- or multi-letter symbol for the study programme or an elective course
R – Second-cycle degree study programme in computer engineering
E – Electrical engineering courses
K – Communications courses
I – Elective courses

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

Workload notation

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

1st Year

Semester 1

Code	*Lecturer*	*Course*	*Weekly workload*					*Examination*	*ECTS credits*
			P	A	L	K	Σ		
DRIK101	Radoslav Galić, PhD, Associate Professor	Discrete Mathematics	2	2	0	0	4	1	5
DR101	Željko Hocenski PhD, Associate Professor	Computer System Design	2	0	2	0	4	1	5
DR102	Željko Hocenski PhD, Associate Professor, Robert Cupec PhD	Control of Dynamic Systems	3	1	1	0	5	1	5.5
DKR101	Drago Žagar PhD, Assistant Professor	Computer Networks	2	1	1	0	4	1	5
DRIK102	Franjo Jović PhD, Full Professor	Automation and Formal Languages	2	1	1	0	4	1	5
		Elective course I					4	1	4.5
		TOTAL:	**11**	**5**	**5**	**0**	**25**	**6**	**30**
	Electives:								
DIR101	Zdravko Valter PhD, Full Professor, Robert Cupec PhD	Elements of Automation	2	1	1	0	4		
DIR102	Ivica Crnković PhD, Full Professor	Software System Design and Modelling	2	1	1	0	4		
DIR103	Prof.dr.sc. T. Švedek	Biomedical electronics	2	1	1	0	4		
DKIR101	Snježana Rimac-Drlje PhD, Assistant Professor	Digital Signal Processing	2	1	1	0	4		
DIKR101	Tomislav Švedek PhD, Full Professor	Microelectronics	2	1	1	0	4		
	Optional courses:								
DF101	Branka Pavlović, MA, Senior Lecturer, Ivanka Ferčec BA, Lecturer	English	1	1	0	0	2		
DF102	Branka Pavlović, MA, Senior Lecturer, Ivanka Ferčec BA, Lecturer	German	1	1	0	0	2		

Semester 2

Code	*Lecturer*	*Course*	*Weekly workload*					*Examination*	*ECTS credits*
			P	A	L	K	Σ		
DR201	Goran Martinović PhD, Assistant Professor	System Programming	3	0	2	0	5	1	6.5
DR202	Franjo Jović PhD, Full Professor	Intelligent Systems	3	1	1	0	5	1	6
DRIK201	Goran Martinović PhD, Assistant Professor	Real-time Computer Systems	3	0	2	0	5	1	6.5
DKR201	Davor Antonić PhD, Assistant Professor	Internet Programming	3	1	1	0	5	1	6
		Elective course II					4	1	5
		TOTAL:	**12**	**2**	**6**	**0**	**24**	**5**	**30**
	Electives:								
DIR201	Davor Antonić PhD, Assistant Professor, Robert Cupec PhD	Basics of Robotics	2	1	1	0	4		
DIR202	Zdravko Valter PhD, Full Professor, Robert Cupec PhD	Process Identification	2	1	1	0	4		
DIR203	Franjo Jović PhD, Full Professor, Robert Cupec PhD	Plant Data Based Modelling	2	1	1	0	4		
DIR204	Ninoslav Slavek PhD, Assistant Professor	Software Quality Assurance	2	1	1	0	4		
DKIR201	Snježana Rimac-Drlje PhD, Assistant Professor	Multimedia Systems	3	0	1	1	5		
DIER201	Zdravko Valter PhD, Full Professor	Process Measurement	2	1	1	0	4		
DIKR201	Vlado Majstorović PhD, Full Professor	Information Technology and Management	2	1	0	1	4		
	Optional course:								
DF201	Branka Pavlović, MA, Senior Lecturer, Ivanka Ferčec BA, Lecturer	English	1	1	0	0	2		
DF202	Branka Pavlović, MA, Senior Lecturer, Ivanka Ferčec BA, Lecturer	German	1	1	0	0	2		

2nd Year

Semester 3

Code	*Lecturer*	*Course*	*Weekly workload*					*Examination*	*ECTS credits*
			P	A	L	K	Σ		
DR301	Davor Antonić PhD, Assistant Professor	Industrial Informatics	3	2	1	0	6	1	7
DR302	Željko Hocenski PhD, Associate Professor	Computer System Reliability and Diagnostics	3	2	0	0	5	1	6.5
DRIK301	Goran Martinović PhD, Assistant Professor	Distributed Computer Systems	3	0	2	0	5	1	6.5
		Elective course III					4	1	5
		Elective course IV					4	1	5
		TOTAL:	**9**	**4**	**3**	**0**	**24**	**5**	**30**
	Elective:								
DIR301	Franjo Jović PhD, Full Professor	Expert Systems	2	1	1	0	4		
DIR302	Davor Antonić PhD, Assistant Professor, Robert Cupec PhD	Robot Vision	2	1	1	0	4		
DIR303	Ninoslav Slavek PhD, Assistant Professor	Software Engineering	2	1	1	0	4		
DIR304	Zdravko Valter PhD, Full Professor	Automatic Electric Drives	2	1	1	0	4		
DKIR301	Drago Žagar PhD, Assistant Professor	Communication Protocols	3	1	1	0	5		
DIKR301	Drago Žagar PhD, Assistant Professor	Network Security	2	1	1	0	4		
DIKR302	Snježana Rimac-Drlje PhD, Assistant Professor	Optical Communications	2	1	1	0	4		
DIER301	Milenko Obad PhD, Associate Proffesor	Computer Integrated Products Devlopment	2	1	1	0	4		
DI301	Ante Lauc PhD, Full Proffesor	Science, Technology, Society	3	1	0	0	4		

Semester 4

Code	*Lecturer*	*Course*	*Weekly workload*					*Examination*	*ECTS credits*
			P	A	L	K	Σ		
D401	Zlatko Lacković PhD, Associate Professor	Management	2	1	0	0	3	1	4
D402	Ninoslav Slavek PhD, Assistant Professor, Vedran Boras PhD, Assistant Professor	Project Management	2	1	0	0	3	1	4
D403	Ante Lauc PhD, Full Proffesor	Introduction to Research Work	2	1	0	0	3	1	4
DS401		Elective course-University					3	1	4
DD401		Thesis	0	0	0	13	13	1	14
		TOTAL:	**6**	**3**	**0**	**13**	**25**	**5**	**30**

3.2. Second Cycle Degree in Computer Engineering (Master level) – Courses description

Semester 1

DRIK101	Discrete Mathematics
Lecturer:	Radoslav Galić, PhD, Associate Professor
Course description: Mathematics logic. Logic operations. Truth tables. Tautologies. Predicate calculation. Whole numbers. Divisibility, prime numbers, congruency. Euler function. Binary relations. Equivalence relations, set partition. Arrangement relations, networks. Binary operations. Algebra structures. Groups. Final group examples. Rings. Whole number rings. Boolean algebras. Boolean algebra presentation. Boolean function. Combinations. Final sets, set product. Counting techniques. Permutations. Permutation groups. Combinations. Variations. Recursive relations. Fibonacci series. Stirling number. Linear recursive formulas. Block designs. Final project planes.	
Knowledge and skills acquired: Students get acquainted with the fundamental linear algebra calculation and algebra structures which are the basis for many other courses. During the lectures and practice the basic concepts will be discussed and by using the examples their efficiency and application will be illustrated.	
Teaching methods: Students are obliged to attend both lectures and exercises.	
Student assessment: During the semester students could take several tests which replace the written examination. This ensures continuous assessment of students' work and knowledge.	
Obligatory literature: 1. D. Žubrinić, Diskretna matematika, Element, Zagreb,2001.	
Recommended additional literature: 1. D. Veljan, Kombinatorna I diskretna matematika, Algoritam, Zagreb, 2001. 2. S. Lipschutz, Discrete Mathematics, McGraw Hill, New York, 1986.	
ECTS credits: **5 ECTS credits** An ECTS credit value has been added according to calculation of required time 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 practice.	
Course assessment: Conducting an anonymous questionnaire filled in by students after the course completion, an analysis of students' final assessments and their overall success.	

DR101	Computer System Design
Lecturer:	Željko Hocenski PhD, Associate Professor
Course description: Computer architecture and organization. Microprocessor. 8-bit microprocessor architecture. Intel microprocessor family. State diagram and usage in design. Instruction set. Addressing modes.Instruction formats. Microinstructions and register transfer languages (RTL). Hardware description languages (VHDL).Microprocessor design. Simple CPU design. Single bus microprocessor design. Two and three buses design. Design verification. Microprocessor control unit design. Microsequencer. Microinstructions and nanoinstructions. Computer arithmetic. Fixed point arithmetic. Floating-point arithmetic. Memory system organization. Cache memory. Virtual memory. Input/output units organization. Programmed input/output. Interrupt system. Direct memory access. Input/output processors. RISC architecture. Instruction set. Pipelining. CISC Architecture. Parallel processing. Parallelism in uniprocessor system. Multiprocessor architecture. Communication in multiprocessor system. Memory hierarchy. Operating system. Alternative parallel architectures.	
Knowledge and skills acquired: Using lectures and individual work student gets knowledge about computer, microprocessor and microprocessor systems design. Students learn to recognize specific microprocessor, microcontroller and computer design problems	

and solving methods. The skills of applying modern software tools for hardware and software design, simulation and verification are obtained. Tools and instruments for development and diagnostics are presented like digital oscilloscopes, programming tools, logic analyzers, 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 programs like WebCT
-Reading from written papers
-Excerses with solved problems-Individual problems solving and team work
-Laboratory practice on completed models and construction of simple own circuits and devices

Student assessment:

-Simple individual problem solving and team work using more complex problems
-On-line testing using e-learning tools like WebCT with questions data base
-Estimation of work in laboratory and estimation of design, construction, testing and presentation of own simple circuits and devices
-Talk with a student to get final appreciation

Obligatory literature:

1. J.D.Carpinelli, Computer Systems Organization & Architecture, Addison Wesley, 2001.
2. V.P.Heuring, H.F.Jordan, Computer Systems Design and Architecture, Addison Wesley, 1997.
3. S.Ribarić, RISC i CISC arhitektura, Školska knjiga, Zagreb, 1994.

Recommended additional literature:

1. D.Sima, T. Fountain, P.Kacsuk, Advanced Computer Architectures- A Design Space Aproach, Addison Wesley, 1997
2. B.B. Brey, The Intel Microprocessors 8086-8088, 80186-80188, 80286, 80386, 80486, Pentium Pro Processor and Pentium II, Architecture, Programming and Interfacing, Prentice Hall, 2000.
3. K. Hwang, D. DeGroot: Parallel Processing for Supercomputers and Artificial Intelligence, McGraw-Hill, New York, 1989

ECTS credits: **5 ECTS credits**

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

Examination methods:

Evaluation of knowledge during lectures and individual problem solving and oral examination

Course assessment:

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

DR102	**Control of Dynamic Systems**

Lecturer: Željko Hocenski PhD, Associate Professor, Robert Cupec PhD

Course description:

Mathematical modelling of processes based on theoretical analysis. State-space representation. Stability of linear continuous control systems. Root-locus method. Controller design in time domain. Analytical controller design methods. Feedforward control. Cascade control. Control of multivariable systems. Discrete control systems. Design of discrete controllers in time and frequency domain. Implementation aspects of PID controller. Control of processes with dead time. Time-optimal control. Predictive control. State-space design of linear continuous and discrete controllers. State estimators. Kalman Filter. Bases of process identification. Introduction to sensitivity theory. Basic structures of adaptive control systems. Model reference adaptive control and self-tuning controllers. Basic properties of nonlinear control systems. Analysis and design of nonlinear control systems.

Knowledge and skills acquired:

Basic knowledge needed for creating mathematical models of several typical processes in industry. Knowledge of discrete control systems. Knowledge of methods which can be used for design of continuous and discrete controllers based on linear mathematical process model. Bases of advanced control methods. Basics of process identification. Bases of nonlinear control systems.

Teaching methods:

Lectures, seminars and laboratory practice.

Student assessment:

Laboratory practice tests, written tests during semester and final examination.

Obligatory literature:

1. N. Perić, Automatsko upravljanje - predavanja, Zavodska skripta, FER, Zagreb, 2004.

Recommended additional literature:

1. G. F. Franklin, J.D. Powell, A.E. Naeini, Feedback Control of Dynamic Systems, Addison - Wesley Publishing Company, 1994.
2. Šurina, T.: Automatska regulacija, Školska knjiga, Zagreb, 1991.3.
3. J. Åström, B. Wittemark, Adaptive Control, Addison-Wesley Publishing Company, 1995.

ECTS credits: **5.5 ECTS credits**

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

Examination methods:

Final examination consists of the written and the oral examination, or of oral examination only for those students who have successfully solved the written tests during semester.

Course assessment:

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

DKR101	**Computer Networks**

Lecturer: Drago Žagar PhD, Assistant Professor

Course description:

Computer network definition. Uses of computer networks. Computer network examples. Network topologies. Computer network hardware, LAN, MAN, WAN, wireless networks. Network software, protocol hierarchy, The relationship of services to protocols. The problems of multiple access, Ethernet, Fast Ethernet, Gigabit Ethernet. The wireless computer networks, IEEE 802.11, IEEE 802.16, Bluetooth. Computer networks internetworking, repeaters, hubs, bridges, switches, routers and gateways. Routing algorithms. Congestion control in computer networks. Flow control in computer networks. Error control in computer networks and basic error detecting codes. Projecting the computer networks. Optimisation problems. Network performance measurement. System design for better performance. Network applications. Computer network security, basic cryptography methods. Firewalls and IDS systems.

Knowledge and skills acquired:

The students will get the knowledge necessary to use and design the computer networks. By successful acquisition of this topic the students will be able to project the basic computer network parameters.

Teaching methods:

Lectures, exercises, laboratory practice. Besides the classical learning methods, the advanced teaching methods, E-learning and demonstrations will be used.

Student assessment:

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

Obligatory literature:

1. A.S. Tanenbaum, Computer Networks , Fourth Edition, Prentice Hall, 2003.
2. A. Bažant, et al, Osnovne arhitekture mreža, Element Zagreb, 2003.

Recommended additional literature:

1. W. Stallings, Data and Computer Communications, Fourth Edition, Macmillan Publishing Company, New York, 2002.

ECTS credits: **5 ECTS credits**

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

Examination methods:

Written and oral examination.

Course assessment:

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

DRIK102	Automation and Formal Languages
Lecturer:	Franjo Jović PhD, Full Professor
Course description: Context-free languages. Context sensitive languages. Derivation tree. Grammars and machines.: Chomsky hierarchy, closure properties, regular and finite languages. Push-down automaton and context free grammars. Parsing. Turing machine and language theory. Fixed point principle and language theory. Inductions. Semantic types: operational, formal and axiomatic. Computability. Problem of programme finiteness and undecidability. Goedel theorem. Church - Turing thesis.	
Knowledge and skills acquired: Development of simple lexer and parser. Validity analysis of a context free programme.	
Teaching methods: Lectures and laboratory practice are mandatory	
Student assessment: Seminar completion, oral examination.	
Obligatory literature: 1. Moll R., Arbib M.A. i Kfoury A.J.: An introduction to formal language theory, Springer Verlag 1987.200 str. 2. Winskel G.: The Formal Semantics of Programming Languages, MIT Press, 1997..350 str.	
Recommended additional literature: 1. Srbljić T. Automati i jezici, Školska knjiga, Zagreb 1998.	
ECTS credits: **5 ECTS credits** An ECTS credit value has been added according to calculation of required time for studying and successful course completion.	
Examination methods: Test and oral examination.	
Course assessment: Conducting an anonymous questionnaire organized and used for lecturer verification and validation. Lecturers who have this course as mandatory will be contacted as well.	

Electives – Semester 1

One elective course has to be chosen. Due to the set standards of student workload to 30 ECTS credits, every elective course carries 4.5 ECTS credits. A student who enrols a larger number of elective courses is not awarded additional ECTS credits.

DIR101	Elements of Automation
Lecturer:	Zdravko Valter PhD, Full Professor, Robert Cupec PhD,
Course description: Measurement of process values: distance, position, angle, angular velocity, force, torque, level, pressure, flow, temperature, pH value and other process values. Signal transfer technologies. Disturbances and their sources. Measurement error. Signal processing. Sensors in control systems. Actuators: DC, AC and step motors, pneumatic, electropneumatic, hydraulic and electrohydraulic devices, pumps, compressors and valves. Thyristor converters and transistor converters. Static and dynamic characteristics of sensors and actuators. Intelligent sensors. Input-output units and interfaces in sensors and actuators.	
Knowledge and skills acquired: Knowledge of principles, properties and methods of application of sensors and actuators used in automatic control. Knowledge needed for integration of sensors and actuators in control systems.	
Teaching methods: Lectures, seminars and laboratory practice.	
Student assessment: Laboratory practice tests and final examination.	
Obligatory literature: 1. J Fraden, Handbook of Modern Sensors - Physics, Designs, and Applications, Second edition, AIP Press, NY 1997.	

2. Z. Kovačić, S. Bogdan, Elementi automatizacije procesa - predavanja, Zavodska skripta, Zavod za APR, FER, Zagreb.

Recommended additional literature:

1. Šantić, Elektronička instrumentacija, Školska knjiga, Zagreb, 1988.
2. J. Tomac, Osnove automatske regulacije - predavanja, Fakultetska skripta, ETF, Osijek, 2004.
3. M. H. Rashid, Power Electronics: Circuits, Devices and Applications, Prentice-Hall International, Inc, Englewood Cliffs, 2003.
4. T. Šurina, Analiza i sinteza servomehanizama i procesne regulacije, Školska knjiga, Zagreb, 1974.
5. Flegar, Sklopovi energetske elektronike - odabrani primjeri, Graphis, Zagreb, 1996.
6. D. Slišković, I. Flegar, Energetska elektronika - Laboratorijske vježbe, Graphis, Zagreb, 1996.

ECTS credits: **4 ECTS credits**

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

Examination methods:

Oral examination

Course assessment:

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

DIR102	**Software System Design and Modelling**

Lecturer: Ivica Crnković PhD, Full Professor

Course description:

Software System Modelling gives students insights in principles for modelling and designing large software systems. Most of todays software systems are large and complex systems which require specification on a higher abstraction level than on a programming language level. The course will give an introduction to an overall, conecptual design, i.e. software architecture. It will give the students theoretical bases for software system designing, architectural definition languages and UML, design patterns, model-based and component-based development. In addition to this the sudents will acquire the practical knowledge through a set of laboratory practice and projects.

Knowledge and skills acquired:

Theoretical and practical knowlage of analysis and design of software systems. Insights into different architectural defiition languages, UML. Writing technical reports.

Teaching methods:

Lectures, laboratory practice, projects

Student assessment:

Practice, project reports

Obligatory literature:

1. Marry Shaw at al, Software Architecture: Perspectives on an Emerging Discipline, Prentice Hall, Upper Saddle River, NJ, 1996.

Recommended additional literature:

2. Ian Sommerville, Software Engineering (6.ed.), Addison Wesley, Boston, MA, 2000.
3. R. Gamma, Design patterns : elements of reusable object-oriented software, Addison Wesley, Boston, MA, 1998.

ECTS credits: **4 ECTS credits**

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

Examination methods:

Laboratory reports, project reports and seminars.

Course assessment:

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

DIR103	Biomedical electronics
Lecturer:	Tomislav Švedek PhD, Full Professor
Course description: Safety measures under electromedical equipment construction. Fundamentals of electrodiffusion. Action potentials. Synapses. Scelet muscles. Human organism control mechanisms. Biomedical potentials (EKG, EEG, EMG, ENG, and ERG). Electrodes. Basic methods of noise reduction in electromedicine. Devices for biomedical potential measurement. Biomedical impedance measurement. Blood pressure and blood flow measurement. Heart murmur measurement. Respiratory system parameters measurement. VF surgical knife. Lasers. Heart electrostimulators and defibrilators. Medical imaging, limits and assessment. RTG. CT. Ultrasound. Nuclear medicine.	
Knowledge and skills acquired: Students will be introduced to biomedical electrical equipment testing for safety measures according to IES safety standards. They will acquire basic knowledge pertaining to biomedicine preparing them for work in interdisciplinary environments.	
Teaching methods: Lectures and laboratory practice.	
Student assessment: Student assessment consists of laboratory practice tests and oral examination.	
Obligatory literature: 1. Ante Šantić: BIOMEDICINSKA ELEKTRONIKA. Školska knjiga, Zagreb 1995.	
Recommended additional literature: 1. -	
ECTS credits: **4.5 ECTS credits** An ECTS credit value has been added according to calculation of required time for studying and successful course completion.	
Examination methods: Oral examination.	
Course assessment: Conducting an anonymous questionnaire filled in by students after the course completion, an analysis of students' final assessments and their overall success.	

DKIR101	Digital Signal Processing
Lecturer:	Snježana Rimac-Drlje PhD, Assistant Professor
Course description: Introduction: characterization and classification of discrete-time signals. Digital processing of continuous-time signals: sampling, aliasing, quantization and reconstruction. The z-transform, regions of convergence, inverse and properties. Linear time invariant (LTI) discrete-time systems; convolution, impulse response, transfer function. Methods for the FIR and IIR filters design. Properties of the discrete Fourier's series and the transformation. Spectral analysis with the DFT and FFT. Time windows. Digital multiresolution signal processing, decimation, interpolation, polyphase decomposition. Adaptive signal processing. Principles of the multidimensional signal processing. Digital signal processing of speech, music, medical images, radar images, application in communication and automation.	
Knowledge and skills acquired: Students will be introduced to the basic techniques for digital signal processing, the FFT applications, as well as the z-transform applications. They will acquire practical knowledge of the digital filter design and of the signal processing in time and frequency domain.	
Teaching methods: Lecture (2 hours per week), problem solving (1 hour), laboratory practice (1 hour)	
Student assessment: Laboratory practice testing, written and oral examinations	
Obligatory literature: 1. A. V. Oppenheim, R. W. Schafer, J. R. Buck: Discrete-Time Signal Processing, Prentice Hall, 1999.	
Recommended additional literature: 2. M.H. Hayes, Digital Signal Processing, Schaum's outlines, McGraw-Hill, 1999.	
ECTS credits: **4.5 ECTS credits** An ECTS credit value has been added according to calculation of required time for studying and successful course	

completion.

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

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

DIKR101	**Microelectronics**

Lecturer: Tomislav Švedek PhD, Full Professor

Course description:
Integrated circuits production technologies: planar silicon technology, hybrid thin and thick film technology. Components of bipolar and unipolar integrated circuits: transistors, diodes, resistors, capacitors. Digital bipolar and unipolar integrated circuits: current switch, basic gates of TTL, ECL, I2L, NMOS and CMOS families. Analog bipolar and unipolar integrated circuits: constant current stages, referent voltage stages, DC voltage level shift stages, basic stages of amplification (CE, CS), differential amplifier, operational amplifier architectures. Techniques of integrated circuit design: PLD, GA, StC, FC. Design principles of complex microelectronic analog and digital circuits: amplifiers, comparators, A/D and D/A converters, filters, wave-shape generators. DFT – design for testability methods in integrated circuits. Introduction to nanotechnology.

Knowledge and skills acquired:
- basic knowledge of integrated circuits production technologies
- basic skills of analog and digital circuit design in one of microelectronics technologies
- skills in leading the IC design projects: from technical requirements, through design of integral sub-circuits, to methods of the circuit testing

Teaching methods:
Lectures, project.

Student assessment:
Written theoretical paper and contribution in IC project design team

Obligatory literature:
1. T.Švedek, Osnove mikroelektronike, Elektrotehnički fakultet Osijek, Osijek, 2002.

Recommended additional literature:
1. P.Biljanović, Mikroelektronika, Školska knjiga, Zagreb, 1983
2. A.S.Sedra, K.C.SMith, Microelectronic Circuits, 3.Edition, Saunders College Publishing, New York, 1991

ECTS credits: **4.5 ECTS credits**
An ECTS credit value has been added according to calculation of required time for studying and successful course completion.

Examination methods:
Tests, discuccion, oral examination

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

DF101	**English** - Optional

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

Course description:
Telephone and data networks. Transmission systems. Switching. Developments in data processing and telecommunications – trends in computer communications. Radio communications. Mobile communications. International Telecoms.

Knowledge and skills acquired:
Reading and understanding texts from the fields of 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 specific fields of students' future profession, understanding and acquisition of specific grammatical structures of the English language, as well as ESP characteristics necessary for basic speech acts, introduction to techniques and methods of reading and writing abstracts as well as

fundamentals of business communication.

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

Obligatory literature:
1. Comfort, J. et al., English for the Telecommunications Industry, OUP, Oxford, 1986.

Recommended additional literature:
1. R.Murphy, English Grammar in Use, CUP, Cambridge, 1995.
2. Scientific and professional journals from the field of communications.

ECTS credits: **0 ECTS credits**
This course is optional and does not carry ECTS credits.

Examination methods:
Written and oral examination.

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

DF102	**German** - optional
Lecturer:	Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Lecturer

Course description:
Grundbegriffe, Energiebergriffe, Energieformen, Energieumwandlung, Elektrizität und unser Alltag, Strom und Physik, Weg der elektrischen Energie, Größen, Einheiten, Kurzzeichen, Mathematik, Strom und Physik.

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

Teaching methods:
Lectures and language practice.

Student assessment:
Written and oral examination.

Obligatory literature:
1. V. Grujoski: Deutsche Fachtexte aus der Elektrotechnik, Sveučilišna tiskara, Zagreb, 1996.

Recommended additional literature:
1. Medić: Kleine deutsche Grammatik, Školska knjiga, Zagreb, 1998,

ECTS credits: **0 ECTS credits**
This course is optional and does not carry ECTS credits.

Examination methods:
Written and oral examination.

Course assessment:
Students' evaluation at the course end.

Semester 2

DR201	**System Programming**
Lecturer:	Goran Martinović PhD, Assistant Professor

Course description:
Requirements on system and application software. Analysis of modern operating systems (Unix, Linux, Windows) in different complexity environments. Design of simple drivers and applications. Basic programming techniques. File and directory control. Control of input-output units and ports. Security services. Memory management. Dll files. Exceptions handling. Processes and threads in programmes: events and exclusion, multithreading. Signals. Interprocess communication: pipes and messages. Fundamentals of network programming: sockets. Design of system software in embedded systems and design of some Win32 and Win64 services. Graphical user interface: windows, controls. Timing function programming. System monitoring and measurement programmes. Approaches and models that enable an increase and evaluation of system performance.

Knowledge and skills acquired:

Knowledge of operating systems possibilities and restrictions, as well as user and environment requirements. Design of reasonably complex, efficient system and application software by using modern programming approaches and tools.

Teaching methods:

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

Student assessment:

Continuous assessment of laboratory practice and homework (occasionally).

Obligatory literature:

1. J.M. Hart, Windows System Programming (3rd Ed.), Addison Wesley Professional, Boston, 2004.
2. M.E. Russinovich, D.A. Solomon, Microsoft Windows Internals (4th Ed.): Microsoft Windows Server(TM) 2003, Windows XP, and Windows 2000, Microsoft Press, 2004.
3. K.A. Robbins, S. Robbins, Unix Systems Programming: Communication, Concurrency and Threads, Prentice Hall, Indianapolis, IN, 2003.
4. S. Walther, Sams Teach Yourself Visual Studio.NET in 21 Days, Sams, Indianapolis, IN, 2003.

Recommended additional literature:

1. A.S. Tanenbaum, Modern Operating Systems (2nd Ed.), Prentice Hall, Englewood Clifs, NJ, 2001.
2. Microsoft Windows Team Staff, Microsoft Windows XP Professional Resource Kit, Microsoft Press, 2003.
3. R. Grehan, R. Moote, I. Cyliax, Real-Time Programming: A Guide to 32-bit Embedded Development, Addison Wesley, New York, NY, 1999.
4. D. Vandevoorde, N.M. Josuttis, C++ Templates: The Complete Guide, Addison-Wesley Professional, Boston, NY, 2002.

ECTS credits: **6.5 ECTS credits**

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

Examination methods:

Written and oral examination. Marks earned in laboratory practice, seminar and homework can replace the written examination and/or increase the final mark.

Course assessment:

Conducting an anonymous questionnaire filled in by students after the course completion, an analysis of students' final assessments and their overall success. Lecturers who treat this course a prerequisite for their courses are also welcome to give feedback about the knowledge acquired during this course.

DR202	**Intelligent Systems**
Lecturer:	Franjo Jović PhD, Full Professor

Course description:

Intelligent agents. Problems and their search spaces. Types of unattended search. Attendded search. Heuristic search algorithms. Logical agents. First order predicate logic. Modal and temporal logic.Deductive and nondeductive reasoning methods. Designing contradictory and undefined systems. Possible worlds. Damster Shafer theory. Ad-hoc and heuiristic learning methods. Structured knowledge. Knowledge presentation.

Knowledge and skills acquired:

Skill in design of algorithms for complex intelligent procedures. Estimation of algorithm calculation time. Algorithm improvement by means of heuristics.

Teaching methods:

Participating to lectures and exercises is mandatory.

Student assessment:

Seminar completion, oral examination.

Obligatory literature:

1. Russel S. i Norvig P.: Artificial Intelligence A Modern Approach, Prentice Hall 200, 1081 str. . .

Recommended additional literature:

1. Jović F.: Expert Systems in Process Control, Chapman and Hall, London, 1992.
2. Patterson D.W.: Introduction to Artificial Intelligence and Expert Systems, Prentice Hall Int. 1990.

ECTS credits: **6 ECTS credits**

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

Examination methods:
Test and oral examination.

Course assessment:
Conducting an anonymous questionnaire filled in by students after the course completion, an analysis of students' final assessments and their overall success. Lecturers that have this course as mandatory will be contacted as well.

DRIK201	Real-time Computer Systems

Lecturer: Goran Martinović PhD, Assistant Professor

Course description:
Classification and examples of real-time systems according to timing requirements. Other requirements and interfaces to environment. Time, timing bases and limits in time measurement. System modelling: task model, time- and event-triggered systems, interrupt processing, WCET analysis. Resource management: scheduling algorithms on single processor and in complex environments. Algorithm complexity. Evaluation parameters. Communication and synchronization. Real-time extensions of operating system. Specialized software tools in embedded systems. Desirable properties of programming languages for system design. Acccess to hardware components from high-level languages. Reliability and availability. Real-time system design: specification, realization, analysis and testing in control, communication, multimedia and some special applications.

Knowledge and skills acquired:
Understanding of timing, as well as other important boundaries by application of today's computer systems. Knowledge and use of relevant methodologies and development tools which enable an increase of system performance.

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

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

Obligatory literature:
1. J.W.S. Liu, Real-Time Systems, Prentice Hall, 2000.
2. R. Grehan, R. Moote, I. Cyliax, Real-Time Programming: A Guide to 32-bit Embedded Development, Addison Wesley, New York, NY, 1999.
3. Burns, A. Wellings, Real Time Systems and Programming Languages: Ada 95, Real-Time Java and Real-Time C/POSIX (3rd Ed.), Addison Wesley, New York, NY, 2001.
4. Selected papers and lecturer's www site.

Recommended additional literature:
1. P.A. Laplante, A Practical Approach to Real-Time Systems: Selected Readings (3rd Ed.), IEEE Computer Society Press, 1997.
2. H. Kopetz, Real-Time Systems Design Principles for Distributed Embedded Applications, Kluwer Academic Publishers, 1997.
3. A.C. Shaw, Real-Time Systems and Software, John Wiley & Sons, Indianapolis, IN, 2001.

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

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

Course assessment:
Conducting an anonymous questionnaire filled in by students after the course completion, an analysis of students' final assessments and their overall success. Lecturers who treat this course a prerequisite for their courses are also welcome to give feedback about the knowledge acquired during this course.

DKR201	Internet Programming
Lecturer:	Davor Antonić PhD, Assistant Professor

Course description:
Internet fundamentals and development. Network adressing and naming of computers, URL, DNS servers. Bases of network programming: client-server and other models, system support for networking. Main network services (telnet, ftp, www) and protocols (TCP/IP). Internet access: SLIP, PPP. World wide web: fundamenatls, browsers, searching. Internet security: intruders and protection. Design of www documents. Client-side technologies: HTML (syntax, standard structure, hypertext, forms), cascade styles, JavaScript, JavaScript and HTML, JavaScript dynamic documents, JavaApplets, XML, DHTML. Server-side technologies: CGI, servlets, PHP, ASP and ASP.NET, cookies. Web approach to databases (PHP/SQL). Web portals. Web design and application examples.

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

Teaching methods:

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

Student assessment:
Continuous assessment of laboratory practice.

Obligatory literature:

1. R.W. Sebesta, Programming the World Wide Web (2nd Ed.), Addison-Wesley, Boston, MA, 2004.
2. F. Halsall, Computer Networking and the Internet (5th Ed.), Addison-Wesley, Boston, MA, 2005.
3. H. Deitel, P. Deitel, T. Nieto, K. Steinbuhler, The Complete Wireless Internet and Mobile Business Programming Training Course, Prentice Hall, New York, NY, 2003.

Recommended additional literature:

1. T. Powell, Thomas, Web Design: The Complete Reference. Berkeley, CA, Osborne/McGraw-Hill, New York, NY, 2000.
2. M. Hall, L. Brown; Core WEB programming, A Sun Microsystems Press/Prentice Hall PTR Book, New York, NY, 2001.
3. K. Kalata, Internet Programming, Thompson Learning, London, 2001.

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

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

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

Electives – Semester 2

One elective course has to be chosen. Due to the set standards of student workload to 30 ECTS credits, every elective course carries 5 ECTS credits. A student who enrols a larger number of elective courses is not awarded additional ECTS credits.

DIR201	Basics of Robotics
Lecturer:	Davor Antonić PhD, Assistant Professor, Robert Cupec PhD,
Course description: Introduction to robotics: basic terms, classification and examples of robots. Description of position and orientation of rigid body. Transformation between coordinate systems. Direct and inverse kinematics of robot manipulator. Denavit-Hartenberg convention. Dynamic model of robot manipulator. Newton-Euler and Langrange method. Position and force control of robot manipulator. Bases of mobile robotics. Robot motion planning. Bases of robot vision.	
Knowledge and skills acquired: Knowledge needed for creating kinematic and dynamic model of the robot manipulator based on its mechanical specifications and application of these models for manipulator control. Bases of mobile robotics. Bases of robot motion planning. Knowledge of sensors used in robotics and basic principles of robot vision.	
Teaching methods: Lectures, seminars and laboratory practice.	
Student assessment: Laboratory practice tests, written tests during semester and final examination.	
Obligatory literature: 1. Z. Kovačić, S. Bogdan, V. Krajči, Osnove robotike, Graphis Zagreb, 2002.	
Recommended additional literature: 1. J. J. Craig, Introduction to Robotics: Mechanics and Control, Addison-Wesley Publishing Company, Inc., 1989. 2. Roland Siegwart and Illah Nourbakhsh: Introduction to Autonomous Mobile Robots, The MIT Press, A Badford Book, 2004. 3. J. C. Latombe, Robot Motion Planning, Norwell, Massachusetts, USA: Kluwer Academic Publishers, 1991. 4. O. Faugeras, Three-Dimensional Computer Vision: A Geometric Viewpoint. Cambridge, Massachusetts: The MIT Press, 1993.	
ECTS credits: **5 ECTS credits** An ECTS credit value has been added according to calculation of required time for studying and successful course completion.	
Examination methods: Final examination consists of the written and the oral examination, or of oral examination only for those students who have successfully solved the written tests during semester.	
Course assessment: Conducting an anonymous questionnaire filled in by students after the course completion, an analysis of students' final assessments and their overall success.	

DIR202	Process Identification
Lecturer:	Zdravko Valter PhD, Full Professor, Robert Cupec PhD,
Course description: Task of process identification. Conducting a data acquisition experiment. Classical methods of process identification. Identification of nonparametric models. Correlation methods of process identification. Identification of parametric models. Nonrecursive and recursive least squares methods. Instrumental variable method. Maximum likelihood method. Validation of mathematical models obtained by process identification. Problems in real time identification. Application of process identification in adaptive control. Identification of nonlinear processes: neural networks, fuzzy and polynomial process models.	
Knowledge and skills acquired: Knowledge which can be used for building of a dynamic process model based on data measurement. Knowledge needed for application of the process identification methods in adaptive control. Practical experience with software	

tools for process identification.

Teaching methods:

Lectures, seminars and laboratory practice.

Student assessment:

Laboratory practice tests and final examination.

Obligatory literature:

1. R. Iserman, Identifikation dynamischer Systeme, Springer-Verlag, Berlin, 1988.

Recommended additional literature:

1. D. Graupe, Identification of Systems, R. E. Krieger Publ. Co, Huntington, 1976.
2. L. Ljung, System Identification - Theroy for the User, Prentice-Hall, Eaglewood Cliffs, 1987.
3. L. Ljung, System Identification Toolbox - User's Guide, The MathWorks Inc, Natick, 1991.
4. W. F. Ramirez, Process Control and Identification, Academic Press, 1993.

ECTS credits: **5 ECTS credits**

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

Examination methods:

Oral examination

Course assessment:

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

DIR203	Plant Data Based Modelling

Lecturer: Franjo Jović PhD, Full Professor, Robert Cupec PhD,

Course description:

Process data-base and process knowledge contained in the historical plant data. Process modelling based on plant data. Data analysis and input variable selection. Data preprocessing and forming the data sets for process modelling. Model structure selection. Regression methods based on input data space projection onto latent structure. Projection onto (hyper)plane and multivariate statistical techniques; PCA, PLS, CR, RR, CCA. Projection onto (hyper)surface (PCS). Projection onto localized surfaces and clastering techniques; k-means, NNC, EMC. Application of artificial neural networks in process modelling based on plant data; MLP, RBF. Hybrid neural network learning. Hierarhical neural networks (HME). Difficult-to-measure process variable estimation example.

Knowledge and skills acquired:

This course of study gives the bases of methods for extraction of process knowledge contained in historical plant data, as well as methods for prediction model building based on this knowledge. In the laboratory practice they gain skills in using available software tools for data analysis and processing, as well as tools for data based modelling.

Teaching methods:

Lectures and laboratory practice.

Student assessment:

Laboratory practice tests and final examination.

Obligatory literature:

Recommended additional literature:

1. Martens, H., T. Naes, Multivariate Calibration, 2nd ed., John Wiley & Sons, New York, 1991.
2. Jackson, J.E., A user's guide to principal components, John Wiley, New York, 1991.
3. Theodoridis, S., K. Koutroumbas, Pattern Recognition, Academic Press, San Diego, USA, 1999.
4. Haykin, S., Neural Networks – A Comprehensive Foundation, second edition, Prentice Hall, 1999.
5. Novaković, B., D. Majetić, M. Široki, Umjetne neuronske mreže, Sveučilište u Zagrebu, Zagreb, 1998.

ECTS credits: **5 ECTS credits**

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

Examination methods:

Final examination consists of the written and the oral examination.

Course assessment:

Conducting an anonymous questionnaire filled in by students after the course completion, an analysis of students'

final assessments and their overall success.

DIR204	Software Quality Assurance
Lecturer:	Ninoslav Slavek PhD, Assistant Professor
Course description: Software Quality program organization. Process quality management. The software crisis. Standardization of quality assurance. The cost of software quality. Static and dynamic analysis aaplied to quality assurance Software reliability. Software reliability management. Software testing. Software maintenance and configuration management.	
Knowledge and skills acquired: Basic knowledge of the computer hardware. Basic knowledge of the system and application software.Basic knowledge of softvare quality	
Teaching methods: Lectures are not obligated, laboratory work is obligated.	
Student assessment: Well finished laboratory practice. Practice can complete test and oral examination.	
Obligatory literature: 1. R. Pressman, Software engineering, McGraw-Hill, 1987. 2. D. Grundler, Primijenjeno računalstvo, Graphis, Zagreb, 2000. 3. Grady Booch: Object-oriented Analysis and Design with Applications, Addison Wesley, Menlo Prk, Cal., 1994.	
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 ECTS credits** An ECTS credit value has been added according to calculation of required time for studying and successful course completion.	
Examination methods: Test and oral examination.	
Course assessment: Conducting an anonymous questionnaire filled in by students after the course completion, an analysis of students' final assessments and their overall success.	

DKIR201	Multimedia Systems
Lecturer:	Snježana Rimac-Drlje PhD, Assistant Professor
Course description: Introduction: areas of application. Fundamentals of human audio and visual perception and their influence on the compression methods. Image representation on a computer; colour models. Compression methods: entropy coding (Runlength, Huffman, aritmetic, LZW). Standards for the still image coding JPEG and JPEG2000. Digitalization of video signal, standards for video compression: MPEG-2, MPEG-4, H261, H263. Characteristics of speech and speech model. Algorithms and standards for speech compression. Digitalization of the audio signals, audio coding. MPEG-7, MPEG-21. Distributed multimedia systems. Packet audio/video in the network environment. Multimedia transport across ATM networks, IP networks and DSLs. Multimedia in mobile communications. Communication protocols for multimedia, quality of services. Videotelephony, videoconferences, interactive television, cabel television, DVB, video surveillance.	
Knowledge and skills acquired: Students will acquire a knowledge of standards for speech, audio and video coding. They will become familiar with multimedia systems and parameters which influence the multimedia transmission quality. Students will make programmes for multimedia processing and will deal with DSP implementation in multimedia applications.	
Teaching methods: Lecture (3 hours per week), laboratory practice (1 hour), constructive practice (1 hour)	
Student assessment: Laboratory practice testing, written and oral examinations.	
Obligatory literature:	

1. R. Steinmetz, K. Nahrstedt: Multimedia Fundamentals: Media coding and Content processing, Prentice-Hall, 2002.
2. K. R. Rao, Multimedia Communication Systems: Techniques, Standards, and Networks, Prentice Hall PTR, 2002.

Recommended additional literature:

1. B. Furht, S. W. Smoliar, H. Zhang: Video and Image Processing in Multimedia Systems, Kluwer, 1995.

ECTS credits: **5 ECTS credits**

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

Examination methods:

Project, written and oral examination.

Course assessment:

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

DIER201	**Process Measurement**

Lecturer: Zdravko Valter PhD, Full Professor

Course description:

Introduction to basic explanations. Measure dimension definitions and measure signal appearances. Static and dynamic behaviours of measuring meters. Active and passive sensors. Tensors. Electrodynamic, piezoelectric, thermo-dynamic, photoelectric, magnetic and chemical sensors. Measuring using PC. Analog/digital converters. Measurement hardware and software. Getting acquainted with measurement software package LabVIEW. Measuring methods and sensors for pressure, level, flow, temperature, moisture and noise. Measuring of other process dimensions. Bus system measuring in the industrial process automation.

Knowledge and skills acquired:

Knowledge necessary for understanding of dynamic dimensions measurement. Getting acquainted with measurement system applications in the industrial processes automation.

Teaching methods:

Lectures, laboratory practice and visit to some industrial plants.

Student assessment:

Creating of several simple application programmes in LabVIEW

Obligatory literature:

1. Valter, Z.: Procesna mjerenja, Script at ETF Osijek, 2004.

Recommended additional literature:

1. Freudenberger, A.: Prozessmesstechnik, Vogel Verlag, Würzburg, 2000.
2. Hesse, S.; Schnell, G.: Sensoren für die Prozess- und Fabrikautomation, Vieweg Verlag, Wiesbaden, 2004.
3. Prock, J.: Einführung in die Prozessmesstechnik, Teubner Verlag, Stuttgart, 1997.
4. Schwetlick, H.: PC-Messtechnik, Vieweg Verlag, Braunschweig Wiesbaden, 1997.

ECTS credits: **5 ECTS credits**

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

Examination methods:

Seminar paper and oral examination

Course assessment:

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

DIKR201	Information Technology and Management
Lecturer:	Vlado Majstorović PhD, Full Professor

Course description:
Introduction. Concept and importance of information technology. Information technology trends. Information technology management. Information technology architecture. Information system in management. Information systems for management support. Systems for decision support. Information technology and entrepreneurship. Role and importance of entrepreneurship. Field of entrepreneur activity. New entrepreneur possibilities and preparations for electronic management transition. Electronic management planning and starting. Internet as a new distribution channel of entrepreneur products. Entrepreneur activities in the electronic management world. Market and information about market before entrepreneur project beginning. Entrepreneur marketing activities. Enttrepreneurship and business ethics.

Knowledge and skills acquired:
Getting acquainted with the funfamental aspects of information technology in terms of creating, development and business possibilities in the global world with special reference to its possibilities and application in the entrepreneurship field.

Teaching methods:
Lectures, problem solving, practice.

Student assessment:
Control tests.

Obligatory literature:
1. V. Čerić, M. Verga, Informacijska tehnologija u poslovanju, Element, Zagreb, 2004.
2. Ž. Panian, Internet i malo poduzetništvo, Informator, Zagreb, 2000.
3. J. Deželjin i dr., Poduzetnički menadžment, M.E.P. Consult, Zagreb, 2002.
4. J. Mishra, A. Mohanty, Design of Information Systems - a Modern Approach, Alpha Science, Bhabaneswar, 2000.

Recommended additional literature:
1. M.L. Tushman, P. Anderson, Managing Strategic Inovation and Change, Oxford University Press, 1977.
2. V. Srića, J, Müller, Put k elektroničkom poslovanju, Sinergija, Zagreb, 2001.
3. G. Curtis, D. Cobham, Bussiness Information Systems - Analysis, Design and Practice, Prentice Hall, Harlow, 2002.

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

Examination methods:
Seminar, tests, discussion and the oral examination.

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

DF201	**English** - Optional
Lecturer:	Branka Pavlović, MA, Senior Lecturer / Ivanka Ferčec, BA, Lecturer

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

Knowledge and skills acquired:
Reading and understanding texts from the field of computer science, 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 specific fields of students' future profession, understanding and acquisition of specific grammatical structures of the English language, as well as ESP characteristics necessary for basic speech acts, introduction to techniques and methods of reading and writing abstracts.

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, Computer Science, Physics, Odjel za matematiku/Elektrotehnički fakultet, Osijek, 2001.

Recommended additional literature:

1. R.Murphy, English Grammar in Use, CUP, Cambridge, 1995.
2. Professional journals from the field of computer science.

ECTS credits: **0 ECTS credits**
This course is optional and does not carry ECTS credits.

Examination methods:
Written and oral examination.

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

DF202	**German** - optional

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

Course description:
Woher kommt der Strom?, Elektrische Unfälle und deren Verhütung, Farbfernsehen, Aus der Geschichte der Elektrotechnik, Von der Windmühle zur Windkraftanlage, Computer beim Autofahren, Prozessautomatisierung, Autofahrer Leit – und Informationssystem, Energieformen und Energieumwandlung.

Knowledge and skills acquired:
Reading comprehension of electrical engineering text, acquiring new vocabulary and new syntactic structures, acquiring new communicative patterns.

Teaching methods:

Lectures and language practice include terminology referring to specific fields of students' future profession, understanding and acquisition of specific grammatical structures of German language, as well as ESP characteristics necessary for basic speech acts, introduction to techniques and methods of reading and writing abstracts.

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

Obligatory literature:

1. V. Grujoski: Deutsche Fachtexte aus der Elektrotechnik, Sveučilišna tiskara, Zagreb, 1996.

Recommended additional literature:

1. Medić: Kleine Deutsche Grammatik, Školska knjiga, Zagreb, 1998.

ECTS credits: **0 ECTS credits**
This course is optional and does not carry ECTS credits.

Examination methods:
Written and oral examination.

Course assessment:
Students' evaluation at the course end.

Semester 3

DR301	**Industrial Informatics**

Lecturer: Davor Antonić PhD, Assistant Professor

Course description:
Production system and industrial plant. Production system control tasks and their stratification. Informatization and automation of production systems. Basic structure of process automation system. Practical examples. System for acquisition and representation of process values. Automatic process control system. Digital implementation of controller. Process computer and programmable logic controller (PLC). Connecting process computer to the process. Operate unit – central unit in process automation system. Operate unit structures: central and decentral, hierarchical and distributed. Supervisory unit – subsystem for operator-production system interface, including the process database. Structures of supervisory unit. Automation components for building of operate and supervisory unit. Communication systems in industry. General purpose information transfer technologies/standards typically used as

basis of some industrial communication standards. Communication technologies at the process level. PLC networks. Software and programming tools in automation systems. Examples of complete control and supervision systems in automated production. Design and maintenance of automation systems.

Knowledge and skills acquired:
This course of study introduces students to the tasks of the production control, and building of automation system. In the laboratory practice students gain knowledge of PLC programming and a methodology of practical control system implementation.

Teaching methods:
Lectures, seminars and laboratory practice.

Student assessment:
Laboratory practice tests and final examination.

Obligatory literature:
1. Perić, N.: Automatizacija postrojenja i procesa - predavanja, Zavodska skripta, FER, Zagreb, 2000.
2. Smiljanić, G.: Računala i procesi, Školska knjiga, Zagreb, 1991.

Recommended additional literature:
1. Jović, F.: Kompjutersko vođenje procesa, Zveza organizacij za tehničko kulturo Slovenije, Ljubljana, 1988.
2. Crispin, A. J.: Programmable Logic Controllers and their Engineering Applications, McGraw-Hill Publishing Company, 1997.

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

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

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

DR302	**Computer System Reliability and Diagnostics**

Lecturer: Željko Hocenski PhD, Associate Professor

Course description:
Failures, faults and errors in computer systems: sources and types. Failure distribution and reliability models. Probability density function, cumulative distribution function, hazard function, reliability, availability, failure rate. Reliability definition and models. Reliability of computer system components. Experimental reliability estimation. Integrated circuits reliability. System reliability. Availability and maintainability. Serial and parallel systems reliability. Fault avoidance methods. System redundancy. Space, time and information redundancy. Dynamic and ststic redundancy. Integrity and dependability of the system. Fault-tolerant system architecture. Fault-tolerant system examples. Fault detection methods. Test generation and performing. Selfdiagnostics systems. Fault-tolerant methods. Fault detectability and fault tolerance, experimental approach. Software reliability and models. System design methods. Computer system specification and validation methods. Verification and validation of computer system.

Knowledge and skills acquired:
Using lectures and individual work students get knowledge of components, digital circuits, devices and system reliability. Students learn about methods and tools for diagnostics and testing of components, digital circuits and systems. Software tools are presented for reliability prediction and calculating of components and systems, fault simulation and prediction as RELEX etc. Students get knowledge of fault avoidance and fault tolerant design.

Teaching methods:
- Lectures using multimedia presentations-Individual learning using CD ROM
- E-learning using multimedia programmes
- Reading from written papers
- Problem solving excercises
- Individual problem solving and team work on problems in components and system reliability and design to get reliability increase and fault tolerance
- Laboratory practice to get experience in design and testing of dependable and reliable fault tolerant circuits and systems.

Student assessment:
-Simple individual problem solving and team work on more complex problems
-On-line testing using e-learning tools like WebCT with questions data base

-Estimation of work in laboratory and estimation of design, construction, testing and presentation of own simple circuits and devices
-Talk with a student to get final appreciation

Obligatory literature:

1. P.D.T.O Connor, Practical Reliability Engineering, John Wiley&Sons, 1991.
2. D. Siewiorek, E. Swarz, The Theory and Practice of Reliable System Design, Digital Press, Bedford, 1982.
3. M.A.Breuer, A.D.Friedman, Diagnosis&Reliable Design of Digital Systems, Computer Science Press, 1989.

Recommended additional literature:

1. B. W. Johnson, Design and Analysis of Fault-Tolerant Digital Systems, Addison-Wesley, Reading, 1989.
2. A.C.Brombacher, Reliability by Design, CAE Techniques for Electronic Components and Systems, John Wiley&Sons, 1992.
3. I.A.Ushakov, ed., Handbook of Reliability Engineering, John Wiley&Sons, 1994

ECTS credits: **6.5 ECTS credits**

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

Examination methods:

Evaluation of knowledge during learning and individual problem solving and oral examination.

Course assessment:

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

DRIK301	**Distributed Computer Systems**

Lecturer: Goran Martinović PhD, Assistant Professor

Course description:

Definition, goals and models of distributed computer systems. Communication: layered protocols, remote procedure calls and object invocation. Processes: threads, client-server processes, code migration, transactions, agents. Naming of distributed system entities. Synchronization: logical clock, global state, algorithms of election and mutual exclusion, transactions. Consistency and replication. Fault tolerance on the process, client-server and group communication level. Security: secure channels, authentication control. Distributed systems based on objects, documents, coordination and services. Distributed environments: clusters and computational grid. Relation computational grid - web services and Internet technologies. Resource management. Models, standards, algorithms, languages and system software. Performance evaluation. Application examples: technical and natural science, virtual enterprises, industrial applications.

Knowledge and skills acquired:

Insight into and fundamental knowledge of properties, prerequisites and ways of design, use and evaluation of distributed computer systems. Overview and use of system and software tools, as well as development of rather simple application programmes in a distributed computer system.

Teaching methods:

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

Student assessment:

Continuous assessment of laboratory practice and homework (occasionally).

Obligatory literature:

1. A.S. Tanenbaum, M. van Steen. Distributed Systems: Principles and Paradigms, Prentice Hall, Upper Saddle River, NJ, 2002.
2. V.K. Garg, Elements of Distributed Computing, Wiley-IEEE Press, Indianapolis, IN, 2002.
3. M. Boger, Java in Distributed Systems: Concurrency, Distribution and Persistence, John Wiley & Sons, Indianapolis, IN, 2001.
4. IEEE Distributed Systems Online: http://dsonline.computer.org.

Recommended additional literature:

1. A.S. Tanenbaum, Modern Operating Systems (2nd Ed.), Prentice Hall, Englewood Clifs, NJ, 2001.
2. J. Blazewicz, K. Ecker, B. Plateau, D. Trystram (Eds.), Handbook on Parallel and Distributed Processing, Springer - Verlag, Berlin, 2000.
3. C.S.R. Murthy, G. Manimaran, Resource Management in Real-Time Systems and Networks, MIT Press, Cambridge, MA, 2001.

ECTS credits: **6.5 ECTS credits** An ECTS credit value has been added according to calculation of required time for studying and successful course completion.
Examination methods: Written and oral examination. Marks earned in laboratory practice, seminar and homework can replace the written examination and/or increase the final mark.
Course assessment: Conducting an anonymous questionnaire filled in by students after the course completion, an analysis of students' final assessments and their overall success. Lecturers who treat this course a prerequisite for their courses are also welcome to give feedback about the knowledge acquired during this course.

Electives – Semester 3

One elective course has to be chosen. Due to the set standards of student workload to 30 ECTS credits, every elective course carries 5 ECTS credits. A student who enrols a larger number of elective courses is not awarded additional ECTS credits.

DIR301	**Expert Systems**
Lecturer:	Franjo Jović PhD, Full Professor
Course description: Statistical learning methods. Pattern recognition. Data preprocessing and quality assurance. Data custering. Uncertain knowledge and decision making. Uncertainty and actions. Srtochastic decision making procedures. Estimation, learning and decision making. Automatic planning.Exercise: designing an expert system application.	
Knowledge and skills acquired: Skills in design and application of the small expert system up to 200 rules. System testing.	
Teaching methods: Participating to lectures and practice is mandatory.	
Student assessment: Expert system completion, oral examination.	
Obligatory literature: 1. Russel S. i Norvig P.: Artificial Intelligence A MOdern Approach, Prentice Hall 2003. 1081 str.2. 2. Jović F.: Expert Systems in Process Control, Chapman and Hall, London 1992. 175 str. .	
Recommended additional literature: 1. Trans. IEEE on Man Machine and Cybernetics	
ECTS credits: **5 ECTS credits** An ECTS credit value has been added according to calculation of required time for studying and successful course completion.	
Examination methods: Test and oral examination.	
Course assessment: Conducting an anonymous questionnaire filled in by students after the course completion, an analysis of students' final assessments and their overall success. Lecturers that have this course as mandatory will be contacted as well.	

DIR302	**Robot Vision**
Lecturer:	Davor Antonić PhD, Assistant Professor, Robert Cupec PhD,
Course description: Introduction to robot vision: basic terms, application of computer vision in robotics, examples. Camera model. Camera calibration. Edge detection. Corner detection. Hough transform. Recognition of two-dimensional and three-dimensional objects. Stereo Vision. Optical flow. Estimating camera pose relative to the operating environment of the robot. Three dimensional scene reconstruction based on a set of images of the scene taken from different positions. Fusion of measurement data obtained by sensors of different types. Environment map building using data obtained by a vision system. Uncertainty of vision-based measurement. Application of computer vision methods for manipulation with objects in robotized production systems and navigation of mobile robots in their operating environments.	
Knowledge and skills acquired:	

Introduction to computer vision and its application in robotics. Knowledge needed for development of a computer vision system which enables manipulation with objects in robotized production systems and navigation of mobile robots in their operating environments.

Teaching methods:

Lectures and laboratory practice.

Student assessment:

Laboratory practice tests, seminar and final examination.

Obligatory literature:

1. O. Faugeras, Three-Dimensional Computer Vision: A Geometric Viewpoint. Cambridge, Massachusetts: The MIT Press, 1993.

Recommended additional literature:

1. R. Hartley, A. Zisserman, Multiple View Geometry in Computer Vision, Cambridge University Press, 2003.
2. B. K. P. Horn, Robot Vision, The MIT Press, 1986.

ECTS credits: **5 ECTS credits**

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

Examination methods:

Seminar and oral examination

Course assessment:

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

DIR303	**Software Engineering**

Lecturer: Ninoslav Slavek PhD, Assistant Professor

Course description:

Software and software engineering. Computer system engineering. Software crisis. Database consideration. System analysis. System specification. Software project planning. Objectives, scope, resources, productive and quality metrics. Project scheduling. Requirement analysis, methods, data flow, data structures. Design Fundamentals, Design process, module design, data design, architcture design, procedure design. Data flow oriented design, data structure oriented design. Object oriented design. Software testing. Software testing and configuration management.

Knowledge and skills acquired:

Basic knowledge of the computer hardware. Basic knowledge of the system and application software.Basic knowledge of softvare quality

Teaching methods:

Lectures are not obligatory, laboratory practice is obligatory.

Student assessment:

Well finished laboratory practice. Practice can complete test and oral examination.

Obligatory literature:

1. R. Pressman, Software engineering, McGraw-Hill, 1987.
2. D. Grundler, Primijenjeno računalstvo, Graphis, Zagreb, 2000.
3. Grady Booch: Object-oriented Analysis and Design with Applications, Addison Wesley, Menlo Prk, Cal., 1994.

Recommended additional literature:

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

ECTS credits: **5 ECTS credits**

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

Examination methods:

Test and oral examination.

Course assessment:

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

DIR305	Automatic Electric Drives
Lecturer:	Zdravko Valter PhD, Full Professor

Course description:
Bases of electrical machines. Synchronous and asynchronous motors. General drive systems. Drives with variable speed. Typical controls for electric drives. Servo drives. Servo motors and stepping motors. Mechatronic systems. High dynamic using Motion Control. Motion Control applications. Electric drives simulating using the software package MATLAB-Simulink and its tool part SimPowerSystems.

Knowledge and skills acquired:
Knowledge necessary for understanding working of an automatic electric drive and getting asquiainted with electric drive applications in the industrial automation processes.

Teaching methods:

Lectures, calculations, laboratory practice.

Student assessment:
Making laboratory reports

Obligatory literature:

1. Valter, Z.: Električni strojevi I i II, Script at ETF Osijek, 2004/05.
2. Wolf, R.: Osnove električnih strojeva, Školska knjiga, Zagreb 1991.
3. Valter, Z.: Automatizirani električni pogoni, Script at ETF Osijek, 2005.

Recommended additional literature:

1. Dolenc, A. i dr.: Električni strojevi, TE/4 JLZ, Zagreb 1973.
2. Gugić, P.: Električni servomotori, Školska knjiga, Zagreb, 1987.
3. Stölting, H.-D.; Kallenbach, E.: Handbuch Elektrische Kleinantriebe, Hanser Verlag, München Wien, 2001.

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

Examination methods:
Seminar work and oral examination

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

DKIR301	Communication Protocols
Lecturer:	Drago Žagar PhD, Assistant Professor

Course description:
Communication model. Communication network architecture. Protocols and protocol architecture. Protocol specification. Protocol verification. Protocol implementation. Protocol validation. Tools for analyses and syntheses of communication protocols. Protocol simulators. Layered approach, OSI model. Hierarchical approach, DoD model. Physical interface and physical layer protocols. Data link protocols. Local networks and protocols: CSMA/CD, WDMA, IEEE 802.11, 802.16. Routing protocols, RIP, OSPF, BGP. Reservation protocols, RSVP resource reservation protocol. IP protocol and internetworking. IPv6 protocol. Control protocols, ICMP protocol. Transport protocols, TCP and UDP. Application protocols, virtual terminal, FTP, SMTP, News, HTTP. Mobile network protocols, GSM, GPRS and UMTS. WAP protocol. Network management protocols, SNMP.

Knowledge and skills acquired:
The students will get the knowledge necessary to use, analyse and design the communication protocols.

Teaching methods:

Lectures, exercises, laboratory practice.

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

Obligatory literature:

1. Gerard J. Holzmann, Design and Validation of Computer Protocols, Prantice Hall, New Jersey, 1991.
2. W. Stallings, Data and Computer Communications, Macmillan Publishing Company, New York, 2002.

Recommended additional literature:

1. W. Stallings, Data and Computer Communications, Fourth Edition, Macmillan Publishing Company, New York, 2002.
2. A. Bažant, et al, Osnovne arhitekture mreža, Element Zagreb, 2003.

ECTS credits: **5 ECTS credits**

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

Examination methods:

Written and oral examination.

Course assessment:

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

DIKR301	Network Security

Lecturer: Drago Žagar PhD, Assistant Professor

Course description:

Introduction to Cryptography. Substitution ciphers. Transposition ciphers. Fundamental cryptographic principles. Symetric-key algorithms, DES, AES, Rijndael. Cipher modes. Cryptanalysis. Public-key algorithms, RSA. Digital signatures. Management of public keys. Certificates. X.509. Communication security. IPsec. Firewalls. IDS. Virtual private networks. Wireless security. Authentication protocols. Shared secret key. Diffie-Hellman key exchange. Key distribution center. Kerberos. E-mail security, PGP, PEM, S/MIME. Web security, SSL. Network privacy.

Knowledge and skills acquired:

The students will get the knowledge necessary to use cryptographic methods and other security mechanisms in communication and computer networks.

Teaching methods:

Lectures, exercises, laboratory practice.

Student assessment:

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

Obligatory literature:

1. C. Kaufman, R. Perlman, M. Speciner, Network security, 2nd ed., Englewood Cliffs, NJ, Prentice Hall, 2002.
2. D.R. Stinson, Cryptography theory and practice, 2nd ed., Boca Raton, FL, CRC Press, 2002.

Recommended additional literature:

1. D. Kahn, The codebreakers, 2nd ed., New York, Macmillan, 1995.

ECTS credits: **5 ECTS credits**

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

Examination methods:

Written and oral examination.

Course assessment:

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

DIKR302	Optical Communications

Lecturer: Snježana Rimac-Drlje PhD, Assistant Professor

Course description:

Theory of optical communications. Light propagation in fibers and power loss. Fiber and fiber nonlinearities. EM modes, modes coupling. Optical detection theory. Optical sources and transmitters. Optical detectors and receivers. Optical amplifiers. Modulations. Direct Detection optical systems. Coherent Systems. Multichannel optical systems (WDM ,FDM, SCM, OTDM). Fiber optic communications networks (LAN i WAN, SONET/SDH). Optical communication in atmosphere, antennas. Standard project procedures (ITU, IEEE).

Knowledge and skills acquired:

To get the knowledge about bases of the optoelectrical communication systems.

Teaching methods:

Students are obliged to attend both lectures and practice.

Student assessment:

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

Obligatory literature:

1. G.P.Agrawal: *Fiber-Optic communication Systems*, John Wiley & Sons, N.Y.,1997.
2. J.Budin: *Optičke komunikacije*, Univerza v Ljubljani, Ljubljana, 1993.

Recommended additional literature:

1. R.Ramaswami, *Optical Networks*, Morgan Kaufman Publishe, INc., 1998.
2. A.Yariv, *Optical Electronics in Modern Communications,* Oxford University Press, Eng.,1996.

ECTS credits: **5 ECTS credits**

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

Examination methods:

Seminar paper and oral examination .

Course assessment:

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

DIER301	**Computer Integrated Products Devlopment**

Lecturer: Milenko Obad PhD, Associate Professor

Course description:

Introduction into the integrated product development methodologies. Main steps. Product and process systematization. QFD (Quality Function Deployment) methodology and its use. CFD (Cuncurrent Function Deployment) methodology and application. FMEA methodology. TVM (Total Value Management) methodologies and their application in the product development. Computer tools for support. Integrated product development architecture. Synchronous CAD. Quick prototype drawing up. Virtual product development. Product development in virtual reality. Animation and simulation in product and process testing and validity. Construction classification. Process support in decision making. Progressive and intelligent models. Intelligent CAD systems. Problems and visions. Intelligence levels. Product intelligence. Process intelligence. Case-base systems. Web systems for automatization of engineering communication and data approach. Network tools and services. Portion bases. Synthesis models. Tools for decision making support. Product and process models based on knowledge. Tools for study.

Knowledge and skills acquired:

Getting acquainted with methodologies and principles in computer integrated product development and with digital product model use in the total development cycle, also with Computer Aided integration methodologies in the development product cycle, as well as with the simulation methods and virtual product development, and intelligence support in the product development.

Teaching methods:

Students are obliged to attend both lectures and practice.

Student assessment:

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

Obligatory literature:

1. J. Usher: "Integrated Product and Process Development: Methods, Tools ,and Technologies"; Wiley 1998.
2. M. Obad: "Dizajn proizvoda uz podršku računala", Sveučilište u Mostaru, Mostar, 2004.

Recommended additional literature:

1. B. Prasad: "Concurrent Engineering Fundamentals: Volume II: Integrated Product Development"; Prentice Hall, 1997.

ECTS credits: **5 ECTS credits**

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

Examination methods:

Seminar paper and oral examination .

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

DI301	Science, Technology, Society

Lecturer: Ante Lauc PhD, Full Professor

Course description:
Introduction: science, technique/technology, society; - Sociology of Science; History, sociology of scientific cognition, social construction of science and technology; - Science: logic and structure of science, fundamental and applied sciences, paradigm in science, history of science and scientific institutions. – Technique and technology: definition, logics and structure of technique, division of technique into disciplines; - Modern science & technology: science and technology as a social matrics of technologies and social values; - Theory of economic and technological determinism, energy/ ecology, social construction of technological systems; - Scientific discoveries, technical inventions and technological innovations; social preconditions and consequences of scientific discoveries, invention as a social process. - Theories about society, social stratification, education and society, technological effects on society, technological accidents, social control of technology. - Profession: definition, social characteristics of professional, professions as social groups, ethical problems of professions; - Elements of profession: role of knowledge, professional monopole, recognition of profession, professional organizations, professional ethics and social responsibility.
Seminar topics from lectures are given in more details:

- Through discussion on examples of scientific discoveries and technical innovations (6 hours), and getting more familiar with
- The scientific information system in Croatia and worldwide (2 hours);
- On-line search of databases (3 hours);
- Cd-roms (1 hour);
- Current contents and similar secundary scientific publications(3 hours)

Knowledge and skills acquired:
Course "Science, Technology, Society" is the first course (among the two) of social sciences at the pregraduate study at the Faculty of Electrical Engineering, providing students with the basic knowledge of science, technicque and technology as well as society necessary for understanding the interaction between these three civilization systems. Acquired knowledge enables students to understand the topics of the specific professional subjects of the study more professionaly and enables them to successfully use the distance leraning methods and sources of information and knowledge also providing necessary know-how and social framework for creating a selfconcept of own profession and enables them for social relations in postindustrial society and European business practice.

Teaching methods:
Lectures and seminars.

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

Obligatory literature:

1. Michael Haralambos – Uvod u sociologiju, Globus,1994.
2. Ivanović, M - Znanost, tehnika, društvo (Science, Technology, Society) - Albert E & Grafika, Osijek 2005,

Recommended additional literature:

1. Zbornik, (ur. D. Polšek), - Sociologija znanstvene poznaje- Hrvatski kulturni dom, Rijeka. 1995.,
2. Čaldarović, O.: - Socijalna teorija i hazardni život, - Hrvatsko sociološko društvo, Zagreb, 1995.
3. Cifrić, I.: - Napredak i opstanak- Hrvatsko sociološko društvo, Zagreb, 1995.
4. Šporer, Z.: Sociologija profesija- Hrvatsko sociološko društvo, Zagreb, 1990
5. Ivanovič, M. - Procesi postkomunističke tranzicije- Albert E & Grafika, Osijek, 2005.

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

Examination methods:
Oral examination .

Course assessment:

1. Insight into the written preparation of lectures and seminars.
2. Students' attendance to lectures.
3. Conducting an anonymous questionnaire filled in by students after the course completion, an analysis of

students' final assessments and their overall success.
4. Passing rate and an average examination mark.

Semester 4

D401	Management
Lecturer:	Zlatko Lacković PhD, Associate Professor

Course description:
Entrepreneurship fundamentals. Strategic management. Operative management. Human resources management. Electronic management. Bussines planning.

Knowledge and skills acquired:
During this course students get acquainted with all the elements of company nmanagement. In this way they could be completely ready to apply their technical knowledge as well as to be independent entrepreneurs i.e. company or specific organization unit managers.

Teaching methods:
Lectures and practice.

Student assessment:
General knowledge testing.

Obligatory literature:
1. Lacković,Z.,Management malog poduzeća,Elektrotehnički fakultet,Osijek,2004.

Recommended additional literature:
2. Deželjin,J., I ost.Poduzetnički menedžment,HITA-CONSULTING,Zagreb,1999.
3. B. Kotruljić: O trgovini i savršenom trgovcu (Venecija, 1573.) m oderno izdanje HAZU, Zagreb, 1985.; Hrvatska gospodarska književna baština I., Zagreb, Birotehnika, 1991.
4. Mill,J.S.,: Principles of political economy some application to social philosophy, Parler, London 1984.
5. Schumpeter, J.; Business Cycles, McGraw Hill, New York 1939.
6. Drucker,P; Inovacije I poduzetništvo,Globus,Zagreb,1992..
7. P. Samuelson: Ekonomija, Mate, Zagreb.
8. P. Sikavica i M. Novak: Poslovna organizacija, (2. izd.), Informator, Zagreb, 1993.
9. Bennett,R.,Management,Informator,Zagreb,1994.

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

Examination methods:
Positively evaluated programme work and oral examination.

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

D402	Project Management
Lecturer:	Ninoslav Slavek PhD, Assistant Professor, Vedran Boras PhD, Assistant Professor

Course description:
Introduction to Project Management. Preliminary project evaluation, Critical decision points, risk evaluation. Project proposal. Project plan, task decomposition, risk analysis, scheduling project. Managing design, structures design, baseline design, system design specification, functional specification, quality assurance. Managing the project team. Marketing for project grow. Postcompletion analysis. Project cost estimating. Optimizing project resources. Software quality control. Project tracking.

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

Teaching methods:
Lectures and practice.

Student assessment:
Well finished laboratory practice. Practice can complete test and oral examination.

Obligatory literature:

1. R. Pressman, Software engineering, McGraw-Hill, 1987.
2. D. Grundler, Primijenjeno računalstvo, Graphis, Zagreb, 2000.
3. Grady Booch: Object-oriented Analysis and Design with Applications, Addison Wesley, Menlo Prk, Cal., 1994.

Recommended additional literature:

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

ECTS credits: **4 ECTS credits**

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

Examination methods:

Test and oral examination

Course assessment:

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

D403	**Introduction to Research Work**

Lecturer: Ante Lauc PhD, Full Professor

Course description:

1. Introduction to science – Definition of science, science structure and logic, structure elements – terms, language, hypotheses, laws, theories, paradigm; Ways of science thinking; relations between science and philosophy, ideology, tehnics, art and politics; Scientific fields (exact, technical, bio-medical, social and humanistic science); Definition of scinetific disciplines (objects and methods of research); Dualisam in science (theory, practice). 2. Researching in exact and technical sciences - Terms of scientific research; definition and features of scientific research; presumtions and logic in scientific researh; fundamental and applied research; Methodology in scientific research (induction, deduction, experiment, simulation). 3. Types of scientific works – Terms and types of research (expert, scientific and technical researches); Category of scientific works, Scientific information. 4. Elements of scientific research – Detection scientific problems, researchnig hypotheses, researching goals, experimental draw (project), addicition and nonaddicion variables, 5. Scientific research phases – Definition of problems and researching goals; bibliography; identification and operacionalisation of researching variables, setting up hypotheses; makig draw of project, methodology and researching technics; interpretation, making deductions and scientific report. 6. Parts of scientific work, scientific project , structure of scientific article. – During the semminars objects are deeper and wider explored – (a) through discussing scientific and technical discoveries and (b) through looking for scientific informations in Croatia and the world, (c) on-line and CD searching databases, (e) through scientific language (rules and syntaxis in scientific speach, scientific abbrevations, biblography etc) and (f) managing projects (structure of project and methodology of team work)

Knowledge and skills acquired:

Providing students with the basic knowledge of science, technics and technology as separate region of human thinking and creativity. Introduction to method of researching and understanding of element researching work. Acquired knowledge enables students to understand the topics of the specific professional subjects of the study more professionally, enables them to successfully use the distance leraning methods and sources of information and knowledge also providing necessary know-how framework for creating a concept of expert project and team work.

Teaching methods:

Lectures and seminars.

Student assessment:

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

Obligatory literature:

1. M. Vujević: Uvod u znanstveni rad, Školska knjiga, Zagreb, 2000.
2. Ivanović, M. - Uvod u znanstveni rad u tehničkim znanostima (Introducing to Researching in Tehnical Sciences)

Recommended additional literature:

1. V. Silobrčić: Kako sastaviti, objaviti i ocijeniti znanstveno djelo, Medicinska naklada Zagreb, 2003
2. K. Popper: Logika naučnog otkrića, Nolit, Beograd, 1973.;
3. T. Kun: Struktura naučnih revolucija, Nolit, Beograd, 1974.

ECTS credits: **4 ECTS credits**

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

Examination methods:
Oral examination .

Course assessment:

1. Insight into the written preparation of lecture and seminars
2. Students' attendance to lectures
3. Conducting an anonymous questionnaire filled in by students after the course completion, an analysis of students' final assessments and their overall success.
4. Passing rate of an average examination mark.

DD401	**Thesis**

Lecturer:

Course description:
While making the thesis a student will solve problems in the field of his/her Master Level under his/her mentor leadership. By successful thesis defense a student will show that he/she can apply all his/her practical knowledge acquired during the study at the faculty.

Knowledge and skills acquired:
Knowledge and abilities for the individual engineering work.

Teaching methods:
Tutorial with mentor.

Student assessment:
Work under the mentor leadership.

ECTS credits: **13 ECTS credits**
An ECTS credit value has been added according to calculation of required time for studying and successful course completion.

Examination methods:
Thesis defense in front of Ph.D. committee.

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