ELECTRICAL ENGINEERING

No.	Neptun Code	Subjects	Semesters																														Prerequisites		
			1.					2.					3.					4.					5.					6.					7.					
			lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr			
35	KMEEL21ANC	Electronics II.											2			ex	2																				34		
36	KMEEL22ANC	Electronics II. Laboratory													2	as	2																				35		
37	KMAAT11ANC	Automation I.											2			ex	3																				1	21	
38	KMAAT12ANC	Automation I. Laboratory													2	as	2																				37		
39	KHTHI11ANC	Communication Technics I.											2			ex	3																				1	21	
40	KHTHI12ANC	Communication Technics I. Laboratory																		2	as	2															39		
41	KVEEE11ANC	Electrical Energetics I.											2			ex	3																				1	21	
42	KVEEE12ANC	Electrical Energetics I. Laboratory (2)																		2	as	2															41		
43	KMEET11ANC	Electronic Technology																2			ex	2															8		
44	KMEET12ANC	Electronic Technology Laboratory																		2	as	2															43		
45	KMEAM11ANC	General Engineering Studies																										2	1		ex	3					25		
Supplementary Subjects																																							
73	(BTOSMA1NEC)	Phisycal Education I.							2		ex																													
74	BGRMAFVNEC	Phisycal Education II.												2		ex																								
Optional Subjects																																							
80	GGTUK11ANC	Business Communication																										2			as	3							
81	GGTSZ11ANC	Sociology																										2			as	3							
Communication Engineering Specialization																																							
46	KHTAT11ANC	Circuit Design																4		2	ex	8															36		
47	KHTHI21ANC	Communication Technics II. (Communication)																4		2	ex	8															37	40	
48	KHTHI31ANC	Communication Technics III. (Signal Processing)																					3		3	ex	7											47		
49	KHTTT11ANC	Telecommunication																					3		2	ex	7											47		
55	KHTIH11ANC	Infocommunication Networks I.																					4		3	ex	8											48	49	
56	KHTIH21ANC	Infocommunication Networks II.																										4		3	ex	8						55		
58	KHTIR11ANC	Operating and Safety of Informatic Systems																															4			ex	6	56		
Optional Subjects																																							
82	KHTSV53ANC	Data and Information Security																					2			as	4													
83	KHTSV71ANC	Mobile Communication																															2			as	3			
Instrumentation and Automation Specialization																																							
46	KMAAZ11TNC	Automatics																4		2	ex	8															36		
47	KMABR11TNC	Embedded Systems																4		2	ex	8															30		
48	KMAJK11TANC	Signal and Image Processing																					3		3	ex	7											27		
49	KMAME11TNC	Engineering Design																					3		2	ex	7											42		

No.	Neptun Code	Subjects	Semesters																													Prerequisites		
			1.					2.					3.					4.					5.					6.					7.						
			lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr			
Basics of Natural Science																																							
1	KMEMA11ANC	Mathematics I.	3	2		ex	6																															
2	KMEMA21ANC	Mathematics II.						3	2		ex	6																									1		
3	KMAIA11ANC	Informatics I.	2			ex	3																															
4	KMAIA12ANC	Informatics Laboratory								2	as	2																									3		
5	KHTIA21ANC	Informatics II.																					2			ex	5										24		
6	KMEFI11ANC	Physics I.											2			ex	4																				2		
7	KMEFI21ANC	Physics II.																2			ex	4															6		
8	KMEVR11ANC	Materials Science	2			ex	3																															
9	KMEVR12ANC	Materials Science Laboratory								1	as	2																									8		
10	KMEMI11ANC	Basics of Safety Technology, Environment Protection and Quality Assurance																										2			ex	5							
Economical and Human Knowledge																																						
11	GGTKG11ANC	Economics I.	2			as	2																															
12	GGTKG21ANC	Economics II.						1	1		as	2																									11		
13	GSVVG11ANC	Enterprise Economics I.																2			as	2															12		
14	GSVVG21ANC	Enterprise Economics II.																					1	1		as	2										13		
15	GVMME11ANC	Management																										2			ex	3					14		
16	GGTJI11ANC	Law																										2			as	2							
Basics of Profession																																						
18	KHTVL11ANC	Electricity I.	3			ex	3																															
19	KHTVL12ANC	Electricity I. Practice		3		as	5																													18		
20	KHTVL21ANC	Electricity II.						3			ex	3																									19	1	
21	KHTVL22ANC	Electricity II. Practice							3	1	as	3																									20		
22	KMAPR11ANC	Programming I.						2			as	2																									3	4	
23	KMAPR12ANC	Programming II. Laboratory													3	as	3																				22		
24	KMAPR22ANC	Programming II.											2			as	2																				23		
25	KMEMD11ANC	Technical Documentation (2)																		2	as	2																	
26	KMAMT11ANC	Measurements						2			ex	2																									19		
27	KMAMT12ANC	Measurements I. Laboratory								2	as	2																									26		
28	KMAMT21ANC	Measurements II.											2			as	2																				27		
29	KMAMT22ANC	Measurements II. Laboratory													2	as	2																				28		
30	KMEDG11ANC	Digital Technics I.	2			ex	4																															
31	KMEDG21ANC	Digital Technics II.						2	1		ex	3																									30		
32	KMEDG31ANC	Digital Technics II. Laboratory													2	as	2																				31		
33	KMEEL11ANC	Electronics I.						2			ex	2																									19		
34	KMEEL12ANC	Electronics I. Practice							1	1	as	2																									33		

No.	Neptun Code	Subjects	Semesters																												Prerequisites		
			1.					2.					3.					4.					5.					6.					7.						
			lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr			
65	KMAGY11ANC	Automatic Manufacturing Systems I.																					4		3	ex	9											46		
66	KMAGY21ANC	Automatic Manufacturing Systems II.																										4		3	ex	9						64		
67	KMAGP12ANC	Automatic Manufacturing Systems Project I.																												2	ex	4						64		
68	KMAIN11ANC	Information Systems																															4			ex	6	66		
69	KMAPR22ANC	Automatic Manufacturing Systems Project II.																																	2	ex	3	5		
Optional subjects																																								
84	KMAIR11ANC	Intelligent Robotic Systems																					2			as	4													
85	KMAOR11ANC	Object Oriented Methodology																					2			as	4													
86	KMARO11ANC	Real-time Operating Systems																															2			as	3			

ex – examination, pm – practice mark, ce – course examination, as - assignement
p - both the subject and the prerequisite can be choosen in the same semester

(1) Sign of course makes necessary to fullfill prerequisites
(2) Semester of the course is determined by the institute responsible for the speciality, according to the amount of students.
Courses signed by character # can be started paralelly, if necessary.
*List of obligatory optional courses is included on last page of the table

BASICS OF NATURAL SCIENCE

1 Mathematics I. KMEMA11ANC
Dr. Aurél Galántai professor

The course covers matrixes, determinants, systems of linear equations, the linear space and its applications, the three forms of a complex number and the rules of operations in these forms, vectors, and operations on vectors, the coordinates of a vector and applications of the vectors. The students will get a deep insight into infinite sequences, boundedness and monotonity, the limit point and the limit of a sequences, fundamental theorems for sequences, the concept of a function and its principal properties. Other main guidelines contain elementary functions, the derivative of a function and its physical and geometrical meaning, differentiation rules, mean value theorems, application of the derivative to the investigation of the behaviour of functions and to the miscellaneous problems, the concept of a function of two (and more) independent variables and its partial derivatives.
The subject also examines the differential of a function and its applications, the indefinite integral, basic integration formulas, integration by parts, integration of rational functions and the method of a change of variables, Riemann integral and its principal properties.

2 Mathematics II. KMEMA21ANC
Dr. Aurél Galántai professor

During the semester the students will learn about several applications of the definite integral (calculating areas, length of the arc of a curve, volume of a solid of revolution etc.), improper integrals, approximate calculation of integrals, Laplace transformation and its principal properties. Other major materials to study include double integral, its principal properties, calculation of the double integral over the normal regions, differential equations, principal first- and second-order differential equations, infinite series and its principal properties.
The students will deal with convergence tests, power series, its principal properties, Taylor and Fourier series, algebra of events, the concept of probability, its principal properties, field of classical probability, the conditional probability, independent events and random variables. Other main topics to be examined are the distribution and the density function, their principal properties, expectation and the variance of a random variable, main discrete and continuous distributions, their characteristics and the central limit theorem.

3 Informatics I. KMAIA11ANC
Dr. György Schuster associate professor

The students will acquire the knowledge of the history of informatics, hardware basics, structure of computers, parts of their functions, classification, working, software basics, software as a critical part of success and software classification. The course also covers number systems and calculation with them, operating system, office systems, database basics, data models (relational, hierarchical, network like ...), CAE systems and their categories, CAD, CAM, CASE. During the semester the students master life cycles models (seve step model) of software waterfall, cyclic, evolutional and their features, measuring of software quality ISO 9126, special systems, embedded systems and integrated information systems. They will also learn about networking, topology, ISO - OSI TCP/IP models, parts of information systems, servers, system organizing, special parts of information systems, DMZ and firewalls.

4 Informatics Laboratory KMAIA12ANC
Dr. György Schuster associate professor

Main materials to examine are C development environment, functions of IDE, editing, compiling, debugging, start file editing, most often used include files, type of variables and their features, operators, categories and their features, instructions, run time instructions (selection and cycles head-tested - tail tested) and other structures. Other major guidelines to study include one dimensional and more dimensional arrays, simple algorithms bubble sorting, linear searching, logarithmic searching, minimum-maximum searching, functions, recursive functions and complex algorithms. The students will also get a deep insight into structures and unions, classical list structures and bidirectional list structures, character handling of display, complex project in C, modular programming, mathematical algorithms, matrix - vector algorithms, usage of mathematical library and their functions.

5 Informatics II. KHTIA21ANC
Dr. György Schuster associate professor

During the course the students will meet classification of operating systems, structure and handling of POSIX compatible operating systems, typical script language, history of script language, PERL evolution, data types of PERL, operators of PERL and instruction of PERL. The course also covers subroutines and competence of variables, modules, blocks, OOP in PERL, TK basics, Basic widgets Main Window, Entry, Label, Button, Check button, IPC basics in Perl, processes, threads and sockets. Other major topics to deal with contain matrix of information, entropy, channel capacity, redundancy, code theory, fit codes, BCD codes, one-step codes, error corrector codes, Hamming codes, cyclic codes, CRC, CRC generation via hardware and software, RSA basics, key generating, key changes, mathematical background of RSA, prime testing and prime searching.

6 Physics I. KMEFI11ANC
Dr. János Orosz associate professor

The students will get a deep insight into mechanics, kinematics, dynamics, mechanical work, kinetic energy, power, systems of particles, motion of rigid body, observational frames of reference, oscillation, wave motion, physics of sound, fluid mechanics, the kinetic theory of gases, optics, Fermat`s principle and wave optics (diffraction, holography). Other main guidelines include thermodynamics, thermodynamic laws, thermodynamic cycle, principles of statistical physics and thermodynamics, theory of relativity (Galilean invariance, relativity of length, Lorenz contraction, time dilation, and special relativity). During the semester the students will study electromagnetic theory (electric charge, electric field, Gauss` law, potential, elementary vector analysis, magnetic force, magnetic field, cyclotron, synchrotron, Faraday's law, and Maxwell's equations).

7 Physics II. KMEFI21ANC
Dr. János Orosz associate professor

In the focal point of the subject there are topics such as black body radiation, photo effect, Compton effect, wave-particle duality, atomic structure (atom models, quantum numbers, Pauli exclusion principle) quantum mechanics, Hilbert space, Heisenberg's uncertainty relation, Schrödinger equation and solution to Schrödinger's wave equation. The students will also get a thorough notion of quantum confinement, quantum entanglement, quantum information, condensed matter physics, types of bonds, electronic band structure, Hall effect, semiconductors, Fermi-Dirac statistics and band gap engineering. Other major materials to study include thermoelectric effects, magnetic properties, Ferro electricity, piezoelectricity, liquid crystals, supra-conductivity, luminescence, lasers, nuclear physics, organizing the nuclides, nuclear force and elementary particle physics.

8 Materials Science KMEVR11ANC
Dr. Sándor Csiszár senior lecturer

Topics are divided into the following categories: physical and chemical background of materials properties; structure of atoms, chemical bonds, some principles of thermodynamics; energy, equilibrium, Gibbs/Helmholtz potentials and basics of solid state physics. The students will also get a deep insight into crystal structure of solids, imperfections in crystals and their impacts on the properties, phase transitions; formation of solids, manipulations of crystal texture, non-crystalline materials and phase diagrams. Other main guidelines to examine contain structure and properties of materials; mechanical-, electrical-, magnetic-, thermal- and optical properties based on solid state physics and quantum mechanics, description of main groups of engineering materials: metals, ceramics, polymers and composites and main aspects of materials selection.

9 Materials Science Laboratory KMEVR12ANC
Dr. Sándor Csiszár senior lecturer

Objectives of the course are the following: introduction to the main methods of investigations used in the electrical industry, as well as to the evaluation methods, and to the preparation of laboratory reports, measurements: mechanical properties: Tensile test, Rockwell and Brinell hardness test on metals.
The students will also deal with microscopy: examination of metallurgical and microelectronic samples, distance measurement on microscopic specimens, stress optical examinations; polarized light, optical anisotropy, birefringence, stress in glasses and plastics. The course also covers insulating materials: measuring volumetric and surface resistance, dielectric properties, and spectrophotometry: measurement of absorption spectra of solutions and evaluations of concentration.

10 Basics of Safety Technology, Environment Protection and Quality Assurance KMEMI11ANC
Dr. Marianna Lendvay associate professor

During the semester the students will learn about the basics of employee's safety, terminology, goals and objectives of employee's safety, requirements and treatments of employee's safety, Importance of work environment, human-machine-environment frame, impairing progression and the basics of risk theory. Other major materials to examine contain electrical safety, the electrically safe work conditions, working on or near live circuits, the effects of electric shock on a human body, the effects depending on type of current, amperage, duration of exposure, pathway of current, body resistance, rescue from electrical contact, first aid for electric shock, direct and indirect contact protection and safety requirements. The course also covers concept of environment protection, principles of environmental politics and decision-maker organizations of EU, means of environmental protection regulation, terminology of energy-efficiency, ways and means for saving energy and water and environmental management systems. The students will also get a thorough notion of the concept of quality assurance, quality systems and standards (ISO 9000), principles of quality control, product reliability, problems of reliability tests and practical applications, reliability calculations of apparatus and systems, the concept of TQM (Total Quality Management) and phases of introducing its application and means of continuous quality improvement.

ECONOMICAL AND HUMAN KNOWLEDGE

11 Economics I. GGTKG11ANC
Dr. András Medve associate professor

Main guidelines of the subject are the following: an introduction to economics, scarcity and efficiency, the three main concepts of economics organization, consumer behaviour, the optimal choice of the consumers and price elasticity of demand. In the framework of this subject the students are also presented consumer surplus, manufacturers' behaviour, company and enterprise, production function, production costs, short and long-term cost functions. The course covers the profit, market structures, offer of companies in perfect competition, long-term supply. Profit maximization of monopoly and oligopolies. The students will examine market of input factors, labour market, capital market, stock market, property market and externalities.

12 Economics II. GGTKG21ANC
Dr. András Medve associate professor

In the focal points of the subject there are topics such as macroeconomics and its interrelations, actors, output and

income, measurement of the macroeconomics performance, macroeconomics cycle, consumption and saving function, demand on the capital market and multiplier effect. The students will also have the chance to study equilibrium income, macro demand, labour market and employment, macro supply, economic equilibrium, the modern money and banking system. Other major materials contain economic growth, conjuncture, inflation and unemployment, the role of the state in economy, fiscal and monetary policy and international trade policy.

13 Enterprise Economics I. GSVVG11ANC
Dr. György Kadocsa associate professor

The students will get a thorough notion of the introduction to integration theory, types and levels of economic cooperation in theory and practice, preconditions of successful cooperations, historical, economic and political reasons for the European integration and the Idea of Europe. Other main guidelines include history of the European integration, the Three Communities (ECSC, EEC, and EAEC), treaties of Rome: vision and objectives, the development periods of the European integration from Rome to Lisbon and establishing the European Union. In the framework of the subject the students are presented free trade agreements between the EU and other countries/integrations, internationalisation of European companies, Hungary's economic connections with the EU member states, Hungary as an EU member state: Process of the integration into the economic and monetary union.

14 Enterprise Economics II. GSVVG21ANC
Dr. György Kadocsa associate professor

The course covers circulation of the resources of the enterprise, management of tangible assets, management of current assets, management of human resources and basics of marketing. The students will have the chance to study about the 4P approach, the process of marketing planning, application of market research methods, and penetration into the markets with new products and existing products. In the framework of this subject the students are presented pricing of products and product life cycles, types of costs, calculation methods used in the enterprises, investment models and calculation methods of the return of investment.
During the semester the following issues will also be examined: net present value, future value of the investment, production management methods, the question of financial balance of the company, classification of the assets and liabilities, the profit and loss account and the balance sheet and reports for the stakeholders.

15 Management GVMME11ANC
Dr. István Szűts associate professor

The students will get an overview of acquiring management theory and practice, self-management, development of leaders' personality characteristics, managerial-organizational knowledge, learning methods and techniques for applying these. The subject also includes development of interpersonal communication skills necessary for managerial activity, mechanisms of decision, problem –solving techniques and their correct application.

16 Law GGTJI11ANC
Dr. István Csillag associate professor

The students will get a deep insight into the history, development and social role of the law, state and law, the concept of law, the legal system and the types of law, hierarchy of sources of law, the concept, validity and effect of the legislation, the legal capacity and certain groups of entities.
In the focal point of the subject there are topics like the place and role of the Constitution in the Hungarian legal system, the social relationships governed by the Constitution, the fundamental citizens' rights and obligations, groupings of public bodies and their main task and authority, the national and local bodies of legislation and enforcement. The subject also deals with the task and authority of the Parliament, the government and the local governments, the judicial authorities, the courts and the prosecutors.

BASICS OF PROFESSION

18 Electricity I. KHTVL11ANC
Dr. Sándor Bognár professor

In the focal point of the subject there are topics like the summary of the basic concepts of vector algebra, scalar and

vector quantity, the law of electrostatic field, Coulomb's law and superposition, the potential, capacity, energy equation and the dielectric constants and the laws of DC network analysis. The students will also learn about Kirchhoff equations and systems of analysis, loop current method, nodal potential method, the theorems of Thevenin and Norton, principle of reciprocity, dividers and Star-Delta transformation. Other major issues to examine contain magnetic field of the electric current, fundamental phenomenon, calculation of the magnetic field intensity, Biot- Savart law, calculation of the induced voltage and magnetic energy. The course also covers the whole system of The Maxwell equations, a description of the AC sine wave time domain, introduction to complex numbers, simple calculation of alternating current networks, power calculation and mean value.

19 Electricity I. Practice KHTVL12ANC
Dr. Sándor Bognár professor

During the semester the students will deal with the summary of the basic concepts of vector algebra, scalar and vector quantity, the law of electrostatic field, Coulomb's law and superposition, the potential, capacity, energy equation and the dielectric constants, DC network analysis. Other main issues to study include Kirchhoff equations and systems of analysis, loop current method, nodal potential method, The theorems of Thevenin and Norton, principle of reciprocity, dividers and Star-Delta transformation.
The students will also get a thorough notion of magnetic field of the electric current, fundamental phenomenon, calculation of the magnetic field intensity, Biot- Savart law, calculation of the induced voltage and magnetic energy. The subject also examines the whole system of The Maxwell equations, problems and solutions, a description of the AC sine wave time domain, introduction to complex numbers, simple calculation of alternating current networks, power calculation and mean value. The students will also have to give presentations of tasks and complete exercises.

20 Electricity II. KHTVL21ANC
Dr. Sándor Bognár professor

The students will get a deep insight into networks with sinusoidal time variation, network analysis using the law of complex algebra, three-phase networks, analysis for the purpose of synthesis, Nyquist representation chart, logarithmical representation and logarithmical units.
The course also covers Bode diagrams- the method due to Bode, four terminal networks, matrix description of four terminal networks, characteristics, parameter, symmetry and reciprocity. Other major issues to study include operating property, reflexes, transmission line, characteristic impedance, periodic flow networks, the Fourier serial examples and transient phenomena. The students will also get a thorough notion of the application of Laplace transformation to simple circuits, integrating and differential connections and calculating simple circuits and switch-off phenomenon.

21 Electricity II. Practice KHTVL22ANC
Dr. Sándor Bognár professor

The course deals with networks with sinusoidal time variation, network analysis using the law of complex algebra, three-phase networks, analysis for the purpose of synthesis, Nyquist representation chart logarithmical representation and logarithmical units. Other major guidelines to follow are Bode diagrams- the method due to Bode, four terminal networks, matrix description of four terminal networks, characteristics, parameter, symmetry and reciprocity. During the course the students will learn about operating property, reflexes, transmission line, characteristic impedance, periodic flow networks, the Fourier serial examples and transient phenomena.
Other main topics to examine contain the application of Laplace transformation to simple circuits, integrating and differential connections, calculating simple circuits and switch-off phenomenon. Problems, solutions and exercise.

22 Programming I. KMAPR11ANC
Dr. György Schuster associate professor

During the semester the students will learn about the history of programming, phenomenon of algorithm, generation of programming languages, their features, and task solution with the help of computers, algorithm descriptor tools and their usability. In the focal point of the subject there are topics such as basic algorithms, sorting, seeking and mathematical algorithms, methodologies and their features, general programming language and its features, history of C and its structure, variables and their prefixes, types, operators, runtime and precompiled instructions, functions. Other major issues to study include pointers, arrays, structures, unions, modules and modular programming, visibility questions, standard function, standard input and output handling printf and scanf, algorithms in C language, mathematical algorithms, Euclidean algorithm, prime algorithms, recursive algorithms and practical viewpoints of implementation.

23 Programming II. Laboratory KMAPR12ANC
Dr. György Schuster associate professor

The students will be given the opportunity to familiarize themselves with low and high level file handling, complex programming project in C language on PC, AVR studio IDE usage, compiling, debugging and other possibilities and preparing start file often used in included files.
Other topics are divided into the following topics: port handling in assembly, LED and button handling, port initialization, various types of assembly instructions and their features, status register, programming structure in assembly, C programmes under AVR8, Functions in AVR8 C, special features of AVR8 C and practical considerations. The course also covers I/O handling and configuration, interrupt handling and main features, time base in C with interrupt, USART handling in C and practical consideration of interfaces, final state machines in AVR 8 under C, trivial threads in AVR8 C, practical considerations and thumb rules and debugging of parallel programmes.

24 Programming II. KMAPR22ANC
Dr. György Schuster associate professor

The main guidelines of the course containing phenomenon of file, low level file handling and their functions, sample programmes, high level file handling and their functions, sample programmes, interfaces between the different levels, dynamic memory handling and its functions, thumb rules and usage, AVR8 microcontrollers' architecture and basics. The students will get a deep insight into memory and IO structure, interrupt handling, special peripherals, assembly instruction set, assembly row format, compiling procedure, simple algorithms in assembly, IT handling in assembly and C programming in assembly.
Other main topics to discuss including comparison the developing procedure between assembly and C environment, development of various modules, IT handling in C, UART handling and interface writing, time base in C, debug and testing and finite state machines in AVR8.

25 Technical Documentation (2) KMEMD11ANC
Dr. Marianna Lendvay associate professor

Goals of technical documentation are the following: seeing in space (2D, 3D), sketching, reading of drawings, and making of tech. drawings by hand/ CAD, making: technical drawing and documentation engineering drawing/ drafting, engineering graphics, technical communication, technical documentation, technical design, picture reading (perception) picture interpretation (apperception) Types of drawing are grouped: 1. Detail drawing 2. Assembly drawing. Documentations are needed for production and control.
The students will meet projection type: perspective and orthographic, representation for plane of projection (no axis) simple elements, drawing description geometry, Making line types: wide/ thick / narrow / thin / dashed / chain / dash and dot, makes sections, and cutting planes section in two parallel planes, local section and revolved section.
Other major issues including crossing hatching of materials, geometric dimensioning and tolerancing, symbol presentations: screws, gear representation, standard drawing scales: full-size, half full-size, five times full size, etc.

26 Measurements KMAMT11ANC
Dr. Elek Horváth professor

The aim of the course is to attain the measuring principles, necessary for measuring basic electrical quantities. The students will acquire the knowledge of construction and handling of most important electrical measuring instruments, interpretation of their technical specification, knowledge necessary to select optimal measuring methods and instruments, basic concepts of measurements, errors in measurements, analogue and digital methods to measure direct current and voltage.
The course also covers measuring alternating voltage, operating principle and specification of mechanical measuring instruments for alternating voltage, classification and parameters of analogue electronic instruments for measuring alternating voltage, AC/DC converters and their specification, digital instruments for measuring alternating voltage and the most important specification.
The students will get a deep insight into current converters, methods to measure electrical resistance, multimeters, generators, sine-wave generators, construction, operation and specification of sound-frequency generators operating principle, setup and handling of waveform generators. Other major topics to examine are principle and specification of synthesizing generators, operating principle, specification, setup and handling of pulse generators, measuring current by converters and oscilloscope. (10 % depart is permitted in thematic for the lecturer.)

27 Measurements I. Laboratory KMAMT12ANC
Dr. Elek Horváth professor

The students will be given the opportunity to attain measuring methods, get basic skill in electrical measurements, practicing handling measuring instruments, evaluation of results of measurements, calculating errors, documenting measurements, get skill in selection of optimal measuring methods and instruments.
The following topics will be discussed: basics of measurements, handling instruments (relation between parameters of the instruments and the errors in measured results), measuring direct voltage and current (analogue and digital instruments), evaluation of results of measurements (cycle of measurements, characteristics), exercising to handle generators (sound frequency and waveform types) and oscilloscope.
During the semester there are guidelines including studying measuring arrangements (capacitive and galvanic disturbances), measuring alternating voltage and current (evaluation of passive and active rectifiers, spectral analysis, measuring distortion) and self-contained measurement (statement of the knowledge got during the semester).

28 Measurements II. KMAMT21ANC
Dr. Elek Horváth professor

The purpose of the course is to attain the measuring principles necessary to measure basic electrical quantities, knowledge of construction and handling of most important electrical measuring instruments, interpretation of their technical specification, knowledge, necessary to select optimal measuring methods and instruments.
The students will get a deep insight into measuring non-electrical quantities, automation of measurements, measurement and simulation of instruments, software in measurements, principle of data acquisition, measuring frequency and time.
In the focal point of the subject there are topics like oscilloscopes II, sampling theory, application of real-time and equivalent sampling theory in sampling oscilloscopes, principle of their operation, specification, application, analyzers, DC power supplies, methods of measuring impedances.
The course also covers bridge methods for measuring impedances, active measurement of impedances, digital method to measure impedances, measuring of electrical power, directions of development of measuring methods and instruments, task of transducers, requirements and specification and application fields of electrically measuring non-electrical quantities.

29 Measurements II. Laboratory KMAMT22ANC
Dr. Elek Horváth professor

During the semester the students will be able to attain measuring methods, to get basic skill in electrical measurements, practicing handling measuring instruments, develop knowledge from the previous semester in field of measuring methods and instruments.
The students will also get a thorough notion of measurement of electrical and non-electrical quantities, special measuring methods and instruments, topics, measuring frequency and time, measuring impedances (voltage and current method, comparative method, two-wire and four-wire method, impedance measurement with active amplifier and measuring electrical power (voltage and current meter, electro-dynamical power meter).
The course covers measurements with oscilloscope, measuring non-electrical quantities (strain-gauge, displacement, temperature, revolution), special measurements and even self-contained measurement (statement of the knowledge got during the semester).

30 Digital Technics I. KMEDG11ANC
Dr. Rita Lovassy associate professor

The students will learn about fundamental principles of digital logic, basic logic operators and logic expressions, Boolean algebra and Boolean functions, definition of logic functions: text description, algebraic form, truth table, logic and graphic representation, logic of identity and logic functions with two or more variables.
Other main topics to discuss include the concept of minterm and maxterm, disjunctive (Sum-of-Products) and conjunctive (Product-of-Sums) canonical forms, logic gates and circuit diagrams, algebraic and graphical minimization, Karnaugh map and applications, analysis of combinational logic circuits using a truth table and using Boolean function.
The students will also acquire the knowledge of synthesis of combinational circuits, combinational circuit design: case studies, numeral systems, binary operations, half and full adder, binary arithmetic: addition, subtraction and multiplication.
Other main materials contain codes, code conversion: case studies, decimal, character and error detection codes, standard combinational components: encoders, decoders, multiplexers, demultiplexers, comparators, etc.

31 Digital Technics II. KMEDG21ANC
Dr. Rita Lovassy associate professor

In the focal point of the course there are issues such as logic circuit generation and families, implementation technologies like TTL and CMOS, general comparison and evaluation of different logic circuits and technologies, latches and flip-flops, synchronous and asynchronous operations, registers, counters, etc., sequential circuits and general concepts. Main topics are divided into the following categories: analysis and synthesis of sequential circuits, simple examples, case studies: 4-bit parity indicator, Gray-code counter, sequential arithmetic circuits, microprocessor basics. The students will also examine datapaths, instruction sets, interrupt handling, interfaces and driver circuits, semiconductor memories and their properties, memory addressing methods, address decoding and interface circuits, analogue-digital, digital-analogue converters and Programmable Logic Devices.

32 Digital Technics II. Laboratory KMEDG31ANC
Dr. Rita Lovassy associate professor

The course covers parameter measurement of different logic families, the way how to use a documentation suite and catalogue, combinational circuit design: case studies, half and full adder, standard combinational components: encoders, decoders, multiplexers, demultiplexers, comparators, etc.
The students will be given the opportunity to familiarise themselves with binary arithmetic: addition, subtraction and multiplication, codes, code conversion: case studies, analysis and synthesis of sequential circuits, simple examples, case studies: 4-bit parity indicator, techniques for measuring synchronous and asynchronous sequential circuits. During the semester the students will study some typical counters like: frequency divider, counter with shortened cycle, arithmetic circuits (full adder, comparator, multiplier, and arithmetic logic unit), design and test of programmable logic units and special measurements.

33 Electronics I. KMEEL11ANC
Dr. Péter Turmezei associate professor

The students will get a thorough understanding of the theory of semiconductors and PN junctions, properties, types and uses of diodes, theory of bipolar junction transistors; DC analysis; CE, CB and CC topologies, current generator circuit, principle of amplification in the transistor circuit; model circuit of transistor; AC analysis. The course also deals with field effect transistors (JFET, MOSFET), FET amplifiers, DC and AC analysis, frequency dependence of transistor circuits, basic theory of analogue amplifiers; properties of feedback and frequency dependency.
Other major topics to study include differential amplifiers, integrated operational amplifiers; inverting and non-inverting amplifier circuits, frequency dependency, current-voltage converter, AC amplifier, basic current and voltage sources, comparators, Schmitt-triggers and waveform generators.

34 Electronics I. Practice KMEEL12ANC
Dr. Péter Turmezei associate professor

The students will meet practice: rectifier diode data sheet, half-wave and full-wave rectifier circuits, voltage reference with Zener diode, uses of varicap diode, DC calculations of basic BJT amplifier and current generator circuits. Other main materials to discuss contain AC calculation of CE and CC BJT amplifier, DC calculations of basic JFET and MOSFET amplifier and current generator circuits, AC calculation of CS JFET and MOSFET amplifier and frequency dependency of BJT and FET circuits. During the semester the students will have the chance to study operational amplifier circuits: inverting and non-inverting amplifier; null-comparator; hysteresis comparator, laboratory practice: computer simulations of diode, transistor and pomp circuits, practical measurement of diodes, BJTs and pumps.

35 Electronics II. KMEEL21ANC
Dr. Péter Turmezei associate professor

In the focal point of the subject there are topics such as applications and design considerations of operational amplifiers, differentiator and integrator circuits, inner components of operational amplifiers, common mode rejection ratio, precision rectifiers and full wave rectifiers with opamps.
The students will also learn about instrument amplifiers with several opamps, multi-stage amplifiers, end-stage amplifiers, amplifier classes, LC and RC oscillators, discrete and integrated analogue and switched-mode voltage regulators and power supplies; parallel and serial voltage regulation. Other main topics belong here are current protection of regulators, analogue multipliers, typical parameters and applications of integrated multipliers: division, root and square circuits, modulators, pulsed circuits and basics of power electronics.

36 Electronics II. Laboratory KMEEL22ANC
Dr. Péter Turmezei associate professor

The main topics related to this subject include this laboratory's supplements: the Electronics II theoretical course, laboratory measurements: time and frequency domain analysis of R - L - C two-ports, pulse technology circuits, tuned analogue circuits, FET amplifier and current generator, symmetric amplifiers and linear application of operational amplifiers.

37 Automation I. KMAAT11ANC
Dr. Péter Kucsera assistant professor

The students will acquire the knowledge of the description of basic concepts of automation, open and closed loop control connection methods and comparison, linear and invariant basic block concept, type of block descriptions in operator and frequency domain, general equations, complex block deduction, process transfer functions and typical process types.
Topics are also divided into categories of process order concept, closed loop control steady state behaviour for setpoint holder and follower control, concept of stability examination methods in operator and frequency domain, control quality examination methods and description. During the semester the students will study build-up and working principle of transmitter, controller and actuator elements, logical description methods of process control, possible controller structure, programmable logic controller types, hardware build-up and programming methods.

38 Automation I. Laboratory KMAAT12ANC
Dr. Péter Kucsera assistant professor

The course covers simple PLC programming experiments (Digital logic, Timers, Counters), using Schneider Zelio intelligent relay, solving textural form simple and complex controlling tasks using the same PLC, simple and complex process block analysis in time and frequency domain using MATLAB. Other main issues to examine contain control loop stability analysis, compensation and quality check, controller tuning for different type of processes, error detection using MATLAB SIMULINK, PT3 loop and P controller simulation and analysis.

39 Communication Technics I. KHTHI11ANC
Dr. Tibor Wührl associate professor

The students will be given the opportunity to familiarise themselves with differential form of Maxwell equations, its significance in telecommunication, basic concepts of signal transmissions, baseband signals, coding, modulation procedures, handling signals in time- and frequency domain and spectrum of signals.
The students will get a deep insight into converting analogue signals to digital, sampling and quantizing, audio and video converters, telecommunication basics: physical layers and its properties, theory of transmission lines, radio channel, parts of the electromagnetic spectrum, spreading properties of electromagnetic waves and analogue and digital ways of recording and storing media.
Other major topics to deal with include compression procedures, the redundancy, and broadcasting: analogue and digital audio and video transmission, home devices, and telecommunication systems: leased line, and switched circuit connections, traffic theory, packet switched and circuit switched networks and terminal equipment. Communication networks, mobile systems, further applications: radio locating, navigation and astronomy are also studied during this course.

40 Communication Technics I. Laboratory KHTHI12ANC
Dr. Tibor Wührl associate professor

Laboratory exercises are carried out in connection with the subjects above. Hardware exercises are as follows: analyzing baseband signal properties, PSTN line observations, filtering techniques, MATLAB simulation: introducing basic usage of MATLAB. Other main guidelines are handling signals, analogue and digital modulation techniques.

41 Electrical Energetics I. KVEEE11ANC
Dr. Ferenc Novothny associate professor

The concept of electrical energetic and its connection to other natural sciences and different fields of electrical engineering are discussed in details. The processes of the electrical power supply and the operation of electrical power systems are demonstrated. The most important characteristics of the electrical power transmission and distribution are

described together with its hierarchy, its guidance and its control.
The electrical machines of the electrical power systems are discussed as follows: power transformers, synchronous and asynchronous machines, and dc machines as well as their constructions, and operation, and their equivalent circuits. Electrical devices and appliances in the electrical power systems are taken into consideration. The types, construction and operation of switch-gears are presented and so are their main characteristics. Typical consumers in the electrical power systems and the generation of the electricity are demonstrated. Types and operation of power plants are discussed together with their main and auxiliary equipment as well. The transmission and distribution of electrical power are discussed together with elements of network systems, as substations overhead lines, cables, their types, constructions, their mechanical and electrical characteristics as well. Devices of the electrical installation of buildings are also discussed.
Design and selection of electrical appliances of the low-voltage distribution network for buildings are demonstrated. The normal operation and characteristic failures of the electrical network systems are discussed. Simple failure calculation, the duties and the operation of the basic protection and control systems are presented.

42 Electrical Energetics I. Laboratory (2) KVEEE12ANC
Dr. Ferenc Novothny associate professor

The course covers the activity in laboratory: multimedia presentation: - hierarchical structure of the Hungarian Power System (HPS), and its operation - power plants, substations, overhead line and cable networks, their construction and operation; - tests on electrical machines (transformers, synchronous and asynchronous machines, universal motors). The students will also get an overview about measurements of loading characteristics together - switchgears, circuit-breakers, fuses; - measurements on consumers, loading; - reactive power compensation and different types of its realization - testing the different operational conditions of overhead lines.

43 Electronic Technology KMEET11ANC
Dr. Ildikó Szenes associate professor

During the semester the students will have the chance to examine discrete electronic parts, integrated circuits and assemblies, manufacturing of printed circuit boards, main steps of mask preparation, etching, galvanic and electroless plating.
Other major materials to study include single side and double side PCB technology, multilayer technologies; foil laminated and sequential, PCB design and design for manufacturing (DfM) and assembly processes: main steps of surface mount technologies.
Other main topics belonging here are stencil printing, component placement, reflow and wave soldering, inspection methods, hybrid integrated circuits and its technology, multichip modules and basics of the semiconductor technology. The students will also deal with advanced packaging, recent R&D's in electronic industry; photonic devices, MEMS (Micro-Electro-Mechanical Systems), nanoelectronics, polymer/printed electronics, environmental and quality assurance aspects of the electronic technologies.

44 Electronic Technology Laboratory KMEET12ANC
Dr. Ildikó Szenes associate professor

In the focal point of the subject there are topics like design of Printed Circuit Boards, computer aided design of Printed Circuit Boards, introduction of ""Eagle"" software package, making schematics, component placement and Design Rule Check (DRC).
Other main topics to discuss are procedure and restrictions of components' manual arrangement - meaning of airwires, correcting component placement based on them, manual and automatic routing, manufacturing processes: preparation of a double side PCB; drilling, making hole conductive, electroless and galvanic plating of copper and tin, mask preparation with solid, negative photoresist and etching. The students will acquire the knowledge of screen printing of the solder resist coating, imaging and developing, hand soldering of TH components and reflow soldering of SM components.

45 General Engineering Studies KMEAM11ANC
Dr. Sándor Csiszár senior lecturer

The main topics related to this subject include balance of forces in electromechanical structures and devices: basic concepts and laws, forces, basic calculation methods, methods of calculation of resultant forces, calculation of centre of gravity, determination of first order moment and of reaction force and concept of constraints.
The students will have the chance to learn basics of stress analysis: concept and kinds of strains, strain functions and diagrams, general problems of design for stress, stress and deformation states, stresses and deformations in bars.

Other major issues to examine are dynamics of electromechanical structures and devices: kinematics of mechanisms and of their elements, kinetics of electromechanical structures and of their elements, thermal stresses, elements of electromechanical structures and devices: locking elements, moving/mobile elements, driving- and actuating elements.

SUPPLEMENTARY SUBJECTS

73 Phisycal Education I. (BTOSMA1NEC)
Györgyné Fehér trainer

Aim of the subject: to provide the conditions of regular sports activities for the students, to advertize the healthy way of living and to draw attention to the preventive values of physical training. Students can choose freely from the branches and courses offered by the Physical Education and Sports Institute.

74 Phisycal Education II. BGRMAFVNEC
Györgyné Fehér trainer

Aim of the subject: to provide the conditions of regular sports activities for the students, to advertize the healthy way of living and to draw attention to the preventive values of physical training. Students can choose freely from the branches and courses offered by the Physical Education and Sports Institute.

OPTIONAL SUBJECTS

80 Business Communication GGTUK11ANC
Dr. Ágnes Csiszárik-Kocsir associate professor

The subject deals with the individual and communication, the need for and the necessity of communication, communication tools, verbal communication, meta- language, paralanguage, the origin and specialities of non-verbal communication, non-verbal communication tools, the relationship between verbal and non-verbal communication. The students will also get a thorough understanding of the significance and role of personal space and distance, credibility, the role of self-knowledge and understanding of human nature in the communication process, „Johari" window, personality types and communicational self-knowledge.
The course also covers impression making, sympathy, empathy, trust; fondle equivalences, communication in the economic environment, organisational culture and communication, formal and informal communication networks, the link between communication and economical efficiency.
The core material also examines the role of motivation, manipulation, critique and compliments at workplaces, conflicts, conflict management techniques, giving lectures and presentations, the role, types of meetings and communication techniques for leading a meeting, career, ambition, curriculum vitae, motivation letter and self-management techniques.

81 Sociology GGTSZ11ANC
Dr. Máté Molnár associate professor

The objective of this course of study is to familiarise the students with the basic concepts and categories of the discipline of sociology; to introduce the structure, strata and functional mechanisms of human society – with a special focus on modern Hungarian society to the students.
The course considers the relationship of sociology to other social sciences and the thoughts and opinions of the most important contributors to the field of sociology. After outlining the theories of societal structure and strata, the course considers the development of Hungarian society in the 20th century in detail. It compares the international and Hungarian trends of social mobility and analyses the position of macro-structural (international, national and ethnic) groups. It gives an overview of the changes in the role of the family and of its adaptation to modernisation as well as the problematic question of Hungarian and international demographics.
Finally, the course gives an overview of the acute problems facing Hungarian society of child-rearing, education, poverty and deviant behaviour types, and it outlines possible methods and solutions to managing and alleviating these problems.

COMMUNICATION ENGINEERING SPECIALIZATION

46 Circuit Design KHTAT11ANC
András Dőring associate professor

The course covers the application of common signal suppression in differential amplifiers, solutions in medical electronics, the applications of differential amplifiers in the field of Telecommunication, the implementation of Mathematical operation with operational amplifier and design of small-signal and power amplifiers. The students will have the chance to study different applications of operational amplifiers in the field of telecommunication, selective amplifiers, different applications of selective amplifiers in the field of telecommunication.
Other main topics related to the subject include structure of microprocessors, communication on the bus between the microprocessors and the system elements, use of the memory and the peripheral interface drivers and the microprocessor as a component. The students will get a deep insight into characteristics of the hardware: the operation and interrupt system of inner memories and in-circuit interfaces, programming of microprocessors and assembler programming. The subject also contains the use of editor, assembler, linker programs, controlled program runnings, data and output interfaces of the microprocessor systems and the presentation of the Developer Tools.

47 Communication Technics II. (Communication) KHTHI21ANC
Dr. Tibor Wührl associate professor

The students will get a thorough notion of signals of telecommunication, description of signals (stochastic and deterministic) in time domain and frequency domain, noises, description of analogue telecommunication systems in time domain and frequency domain. Other main topics to discuss include transfer functions, distortions, design of analogue filters, modulations, description of modulated signals in time domain and frequency domain, shift keying methods, fundamentals of broadband access techniques and basics of digital signal processing. The course also covers sampling process, Nyquist-Shannon sampling theorem, quantization, coding, restoration of sampled signal, description of digital systems in discrete time domain and frequency domain.
The students will be given the opportunity to familiarise themselves with voice coding, prediction methods, design of digital filter structure (FIR), basics of spectrum analysis, Discrete Fourier Transformation, Fast Fourier Transformation and Fundamentals of TDMA (Time Division Multiple Access) systems. The subject contains line signals in time domain and frequency domain, Shannon's thesis, intersymbol interference, Nyquist criteria, Basics of FDM, TDM and WDM transmission systems, laboratory: Fourier analysis. Other major guidelines are the following: description of periodic signals in time domain and frequency domain, study of stochastic signals, system analysis in frequency and complex frequency domain, analogue and digital modulation methods. The students will also get an overview about sampling process, quantization, discrete-time systems, spectrum analysis, Discrete Fourier Transformation, Fast Fourier Transformation, digital signal transmission via analogue transport channel.

48 Communication Technics III. (Signal processing) KHTHI31ANC
Dr. Tibor Wührl associate professor

The main topics belonging here are the following: principal summary: the basics of mathematical simulations, basics of MATLAB, the summary of the source language programming, the generation of “”m”” source files; Basic principle of design and simulation of direct structure digital filters (FIR, IIR); Bilinear- and discrete Laplace transformations. In the focal point of the subject there are signal processing structures, overview of the DSP core commands, method of number representation (fixed and floating point), the effects and their elimination of the phenomena of quantization and overflow.
The course also covers granular nonlinearities, phenomena of limit cycles and their oppression, basics of wave digital signal processing, and the conception of the passivity; software structures of digital signal processors. Other major materials to study contain TIMER controlled DSP tasks, and sampling frequency, decimal and interpolate methods in practice. Laboratory exercises include practice the MATLAB programming, preparing “”m”” files, matrix operations, graphic surfaces; simulation of digital filters with MATLAB (transmission functions, impulse answer); design of digital filters with MATLAP, simulation and performance of programmable structures. The students will also study simulation of modulation and demodulation processes with MATLAB Programming of DSP demo card, developed and simulated object programming into a signal processor with the help of MATLAB.

49 Telecommunication KHTTT11ANC
Dr. Zsolt Temesvári associate professor

The students will get an overview of basic definitions, level terms, transfer attenuations, reflexion-, symmetry attenuations, nonlinear circuits, measurements of harmonic-; inter modulation- and stochastic distortion. The

subject also contains noise definitions, noise factor and its measurement, psophometric noise measurement, noise measurements in the analogue and digital channels. Other main topics belonging here are running time, phase rotation, group delay time definitions and measurements methods, jitter and measurements, the characteristics of the transmission lines (copper and optical). The students will also get a thorough notion of the basics of informatics theory, signal element, spectrum, transmission methods of different information types, wave form and hybrid speech coders, the characteristics of MPE, RPE, CELP coders, lossless and loss compression techniques in the field of video- and streaming technology.
The course also covers channel coding, error indicator processes, ARQ process, block- and convolution coding. Laboratory practice includes basic instrument practice with Agilent instruments, measurements of active and passive filters, cable measurements, testing the transmission characteristics of telecommunication circuits, time and phase measurements, testing patch cables, radio transmission measurement with spectrum analyser, simulation of transmission systems with expanded spectrum (CDMA)Simulation of channel coding (Viterbi, Trellis, etc.) and simulation of failure exploratory methods.

55 Infocommunication Networks I. KHTIH11ANC
Dr. József Beinschróth associate professor

In the focal point of the subject basic concepts, network architectures, questions of standards, OSI Reference Model, layers, protocols, primitives and TCP/IP (Transmission Control Protocol / Internet Protocol) can be found. The students will also have the chance to learn about layers and main features, comparing OSI and TCP/IP, the hybrid model, physical layer, physical medium, baseband transmission and serial transmission. Other main topics to discuss are modems data link layer, data link protocols, character and bit oriented procedures, media access layer and multiple access protocols.

56 Infocommunication Networks II. KHTIH21ANC
Dr. József Beinschróth associate professor

During the semester the following topics are introduced: network layer: basic concepts, transport directing algorithms, congestion defended protocols, quality of services and interconnection of networks. The students will learn about network layer of internet, transport layer, TCP (Transmission Control Protocol), UDP (User Datagram Protocol), application layer, classical application and web technologies. Other major issues to study include multimedia network security, cryptography, IPSec (Internet Protocol Security), VPN (Virtual Private Network) and defence in boundary of network.

58 Operating and Safety of Informatic Systems KHTIR11ANC
Dr. József Beinschróth associate professor

The course covers basic concepts, international, standard and technical solutions in IT security, threats against IT systems, providing of IT Systems, designing of IT security, business continuity management, COBIT and ITIL Service Desk, SLM incident and problem management, change and release management.

OPTIONAL SUBJECTS

82 Data and Information Security KHTSV53ANC
Dr. Beinschróth József associate professor

Subject deals with basic concepts of data and information security and relevant international standards and technical solutions. Business continuity management COBIT, ITIL Service, SLM Incidents and problem management are also presented.

83 Mobile Communication KHTSV71ANC
Dr. Dóra Maros associate professor

From 2G (GSM) to 4G (LTE) systems and their radio propagation features and models are in the focus of the subject. Mobile service quality (QoS) characterization and transmission parameters are also presented.

INSTRUMENTATION AND AUTOMATION SPECIALIZATION

46 Automatics KMAAZ11TNC
Aurél Vajda associate professor

The students will get a deep insight into setting of work-point of linear closed loop control systems, constant value controlling systems and set point follower controlling systems, stability of complex control systems, A 'Z' transformation, stabilization and quality of sampled control systems under time and 'Z' domain. The course also covers adaptive control systems, non-linear control systems, two and three level controllers and their block charts, technical features of controllers, sensors and different generation of electrical transducers. Other major issues include digital controllers and their applications, basics of pneumatics, different generation of electrical and pneumatic effectors and parts of open loop control systems.

47 Embedded Systems KMABR11TNC
Gyula Zsom associate professor

The students will acquire the knowledge of basics of embedded systems and their applications field, applications of micro controller in embedded systems, hardware questions and their development environments, software questions and their development environments. Other main topics to discuss are applications of programming logics CPLD, FPGA, basics of computer networks, OSI and TCP – IP models, protocols and their applications, types of servers and security of computer networks. The course also deals with micro and board buses (RS232C, I2C, CAN, LIN Flexray), laboratory exercises PIC microcontroller programming in assembly and C language, linear circuit testing considering stability and other features, switching power supply testing, simulation of analogue and digital circuits.

48 Signal and Image Processing KMAJK11TANC
Dr. József Kohut associate professor

In the focal point of the subject there are features of deterministic signals under time, and amplitude domain, average - like features of signals, periodic signals and their Fourier sequence, aperiodic signals and their Fourier transformation, basics of sampling such as mathematical and physical sampling. The students will have the chance to study Fourier spectrum in case of sampling, reconstruction of the original signal from regularly sampled one, irregular sampling and un-overlapping filter. During the semester the students will examine theories of physical sampling, reconstruction of sampled signals with filters and sampling and hold circuit, discrete Fourier transformation basics, effects of windowing and methods of image.

49 Engineering Design KMAME11TNC
Károly Baka senior lecturer

The students will get a deep insight into features of electrical parts, resistors, capacitors and their catalogue data, magnetic material, inductive parts, optoelectronic parts, passive parts, wires, strings, switches, connectors and plugs and their features, 19" rack systems and their applications. The students will also get an overview about design methods of printed circuit boards, PCB technologies and testing in case of multilayer design, grounding methods and power supply of devices, shielding of devices, EMC and ESD questions, thermal design of devices and design of cooler part. Other major materials to study include drawing of building, 3D charts using CAD systems, documentation of building automation, block charts, cable lists, path lists. graphical phase diagrams, commonly used symbols and their usage in case of CAD systems.

65 Automatic Manufacturing Systems I. KMAGY11ANC
Dr. György Schuster associate professor

The students will be given the opportunity to familiarise themselves with structure of classical process control computers, their peripherals and applied algorithms, classification of production systems, basic phenomenon and their application fields. The course also covers subsystems of production systems, material handling subsystems, processing subsystems, testing subsystems and subsystems of informatics. The students will also learn about structure and machines of electrical and electronic production systems, front end and back end lines, SMT devices, re-flow ovens, visual and RTG testers, ICT-s, FDL-s, etc., structure and machines of mechanical production systems. In the focal point of the subject there are topics like CNC milling and lathe machines, cutting machines (laser, plasma, water jet), integrated CNC chamber, etc., sensors and actuators, simple binary sensors, industrial robots, kinematic chain, driving

system, control system and programming. The students will have the chance to study about flexible manufacturing cell, laboratory exercise, and physical devices: pneumatic manipulator, traffic light, production machine controlled by embedded controller, PLC and PC.

66 Automatic Manufacturing Systems II. KMAGY21ANC
Tamás Sándor senior lecturer

During the semester the students will deal with review of object oriented methodology, simulation methods, network programming, soft computing methods (fuzzy logic, neural networks, genetic algorithms) and application in case of automatic production systems.
Other major topics include intelligent sensors (vibration sensors, vision modules, load sensors, etc), industrial robots and intelligent sensors, mixed type production systems (ship yard, plane production), viewpoint for building them, informatics of production systems and their connection to other information systems of the company.
Laboratory exercise contains TCP/IP programming using several protocols. RS232C, I2C (TWI), CAN bus, LIN bus programming. Usage of FPGA (simple logical application, sequential application, soft processors) and usage of 32 bit microcontrollers.

67 Automatic Manufacturing Systems Project I. KMAGP12ANC
Tamás Sándor senior lecturer

Students have to achieve an entire development process. They can work alone or in small groups. During the semester they have to present their works twice. Task should be interdisciplinary it should contain electrical, software and mechanical parts. Students should manufacture those devices. We consider it very important that documentation of the project will be prepared.
Task can be a solvable problem in the laboratory, such as models, devices, machines or can be real industrial projects. Institute has several ones for this goal in the Automatic Production Systems Laboratory.

68 Information Systems KMAIN11ANC
Tamás Sándor senior lecturer

The students will get a thorough notion about basics of database handling, data models and their normal forms, process of normalization, SQL knowledge, DDL, DML, DQL, MSQL application in various systems and structure of distributed systems.
The course also covers distributed system design, reliability questions of distributed systems, structure of an information system in case of a company and their main parts, basic of data mining, basic of statistic, basic of statistical process control. Other major guidelines are the following: phenomenon of statistical quality assurance, usual application, structure of quality system of a company, role of integrated control systems in a company, test and review methods. The students will also study periodically and non periodically reviews and their methods, information security and their elements and control systems, application attachment in case of a given company.

69 Automatic Manufacturing Systems Project II. KMAPR22ANC
Tamás Sándor senior lecturer

Students have to achieve an entire development process. They can work alone or in small groups. During the semester they have to present their works twice. Task should be interdisciplinary it should contain electrical, software and mechanical parts. Students should manufacture those devices. We consider it very important that documentation of the project will be prepared. Task can be a solvable problem in the laboratory, such as models, devices, machines or can be real industrial projects. Institute has several ones for this goal in the Automatic Production Systems Laboratory. Students have the opportunity to carry on with the previous semester project.

OPTIONAL SUBJECTS

84 Intelligent Robotic Systems KMAIR11ANC
Dr. György Schuszter associate professor

The aim of the subject is students should have the opportunity to learn applications of industrial robots and their features. The subject contains several case studies and smart solutions on industrial problems based on intelligent

automation and application of robots. Additional topic is the protective features of industrial and non industrial robotics.

85 Object Oriented Methodology KMAOR11ANC
Dr. György Schuszter associate professor

This subject shows the main features of object oriented programming languages based on students' software technology knowledge. As a tool of this C++ programming language is to help and explain most common flavors of OOP. In the second half of the semester an object oriented script language is introduced.

86 Real-time Operating Systems KMARO11ANC
Dr. György Schuszter associate professor

Real-time problems are almost the most common tasks of software and other kind of engineering. This subject intends to show the main features of real-time problems and presents some of the most commonly used real-time operating systems. Another aim is students should be able to handle at least one RT operating system in practice.