University of Debrecen

Centre of Arts, Humanities and Sciences

Hungary

Faculty of Science

Electrical Engineering, BSc Program

CURRICULUM

ELECTRICAL ENGINEERING

			Term						
	Code	**Subject**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Core Module (44 credits)									
1	TMBE0603	Mathematics 1	4/2/0/e/**5**						
2	TMBE0604	Mathematics 2		4/2/0/e/**6**					
3	TMBE0605	Mathematics 3			4/2/0/e/**6**				
4	TFBE1101	Physics 1	3/1/0/e/**5**						
5	TFBE1102	Physics 2		3/1/0/e/**5**					
6	TFBE1103	Materials Science for Electrical Engineering	3/1/0/e/**5**						
7	TFBE1104	Introduction to Informatics	2/0/2/p/**4**						
8	TFBE1105	Computer Architectures		2/0/3/e/**5**					
9	TTBE0141	Introduction to Chemistry	2/0/0/e/**3**						
Economics and Human Knowledge (18 credits)									
10	TFBE0040	Fundamentals of Environmental Science	1/1/0/e/**2**						
11	TFBE1108	Economics		2/0/0/e/**3**					
12	TFBE1109	Introduction to the EU			2/0/0/e/**3**				
13	TFBE1110	Fundamentals of Civil Law				2/0/0/e/**3**			
14	TFBE1111	Economics of Enterprises					4/0/0/e/**4**		
15	TFBE1112	Intellectual Property Protection						2/1/0/e/**3**	
Advanced Professional Module (89 credits)									
16	TFBE1201	Programming 1	2/4/0/e/**6**						
17	TFBE1202	Programming 2		2/4/0/e/**6**					
18	TFBE1203	Measurement and Instrumentation 1		2/0/3/e/**5**					
19	TFBE1204	Measurement and Instrumentation 2			2/0/3/e/**5**				
20	TFBE1205	Electricity			4/2/0/e/**6**				
21	TFBE1206	Networks and Systems				4/2/0/e/**6**			
22	TFBE1207	Electronics 1			3/1/0/e/**5**				
23	TFBE1208	Electronics 2				3/0/2/e/**5**			
24	TFBE1209	Digital Electronics 1			3/2/0/e/**5**				
25	TFBE1210	Digital Electronics 2				2/0/4/e/**5**			
26	TFBE1211	Electronic Technology					3/0/2/e/**5**		
27	TFBE1212	Automation 1				3/1/0/e/**5**			
28	TFBE1213	Automation 2					3/1/0/e/**5**		
29	TFBE1214	Telecommunication					3/1/0/e/**4**		
30	TFBE1215	Microelectronics				3/2/0/e/**6**			
31	TFBE1216	Electric Power Systems					3/2/0/e/**5**		
32	TFBE1217	Production and Quality Management						2/0/3/e/**5**	
Optional Professional Subjects (49 credits)									
33		Theoretical subjects of the specialization					2/0/2/e/**4**	5/0/2/e/**8**	6/2/1/e/**10**
36	TFBL1401	Stand-alone laboratory 1					0/0/3/p/**3**		
37	TFBL1402	Stand-alone laboratory 1						0/0/4/p/**4**	
38	TFBL1403	Stand-alone laboratory 1							0/0/5/p/**5**
39	TFBL1404	Thesis 1						0/5/0/a/**5**	
40	TFBL1405	Thesis 2							0/10/0/**10**
Free Optional Subjects (10 credits)									
41		Free-selected subject 1						1/2/0/e/**2**	2/0/0/e/**2**
42		Free-selected subject 2						2/1/0/e/**3**	2/1/0/e/**3**
43		Sport	0/2/0/s/**0**	0/2/0/s/**0**	0/2/0/s/**0**	0/2/0/s/**0**			
		Hours per week	**28**	**28**	**28**	**28**	**28**	**28**	**28**
		Total credits	**30**	**30**	**30**	**30**	**30**	**30**	**30**
		Examinations	**6**	**6**	**6**	**6**	**6**	**6**	**5**

a/b/c/d/f - lecture/practical/laboratory/examination form (e – examination; p – practical grade; s – signature)/credits

ELECTRICAL ENGINEERING

ELECTRICAL ENGINEERING, **INFOTECHNOLOGY** SPECIALIZATION **Responsible: Dr. Sándor Kökényesi**

			Term						
	Code	**Subject**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. Infotechnology specialization									
1	TFBE1601	Photonics					2/0/2/e/**4**		
2	TFBE1602	Nanotechnology						3/0/0/e/**4**	
3	TFBE1603	Nanoelectronics						3/0/0/e/**4**	
4	TFBE1604	Digital Signal Processing							1/0/2/e/**3**
5	TFBE1605	Complex Design of Digital Systems							2/1/0/e/**4**
6	TFBE1606	Materials Science Fundamentals of Information Technology							2/0/0/e/**3**
7	TFBL1401	Stand-alone laboratory 1					0/0/3/p/**3**		
8	TFBL1402	Stand-alone laboratory 2						0/0/4/p/**4**	
9	TFBL1403	Stand-alone laboratory 3							0/0/5/p/**5**
10	TFBL1404	Thesis 1						0/5/0/p/**5**	
11	TFBL1405	Thesis 2							0/10/0/**10**
		Credits					**7**	**17**	**25**

ELECTRICAL ENGINEERING, **AUTOMATION** SPECIALIZATION **Responsible:** Dr. Sándor Misák

			Term						
	Code	**Subject**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2. Automation specialization									
1	TFBE1701	Electrical Machines and Drives					2/0/2/e/**4**		
2	TFBE1702	Computer Controlled Measurement and Process Control						2/1/0/e/**4**	
3	TFBE1703	Identification and Control Systems						2/0/1/e/**4**	
4	TFBE1704	Programmable Logic Controllers (PLC)							2/0/2/e/**4**
5	TFBE1705	Power Electronics							2/0/0/e/**3**
6	TFBE1706	Sensors and Actuators							2/0/1/e/**3**
7	TFBL1401	Stand-alone laboratory 1					0/0/3/p/**3**		
8	TFBL1402	Stand-alone laboratory 2						0/0/4/p/**4**	
9	TFBL1403	Stand-alone laboratory 3							0/0/5/p/**5**
10	TFBL1404	Thesis 1						0/5/0/p/**5**	
11	TFBL1405	Thesis 2							0/10/0/**10**
		Credits					**7**	**17**	**25**

FREE OPTIONAL SUBJECTS

			Term						
	Code	**Subject**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Free Optional Subjects									
1	TFBE1501	Energy Sources							2/0/0/e/**2**
2	TFBE1502	Magnetic Materials						2/0/0/e/**2**	
3	TFBE1503	Application of Microcontrollers						1/2/0/e/**2**	
4	TFBE1504	Interfaces							1/2/0/e/**2**
5	TFBE1506	Nuclear Electronics						2/0/1/e/**3**	
6	TFBE1507	Applied Electronics						1/0/2/e/**2**	
7	TFBE1508	Digital Image Engineering							2/1/0/e/**3**
8	TFBE1509	Property Protection and Alarm Systems							2/1/0/e/**3**
9	TFBE1510	Robotics							2/0/0/e/**2**

DESCRIPTION OF SUBJECT PROGRAM

Subject: TMBE0603 Mathematics 1
Classes/week: 4 hour lecture, 2 hour seminar
ECTS Credit Points: 5
Prerequisites: -
Lecturer: Péter T. Nagy, DSc

Topics: Integers, rational numbers, real numbers, complex numbers. Basic combinatorics. Vector algebra, coordinates, matrices, matrix operations. Determinant and its properties; rank of a matrix; system of linear equations. Sequences of real numbers, convergence. The notion of function, limit, continuity. Curves and equations. The slope of a curve, the derivative. The derivative of sums, products, quotients. The chain rule, inverse function and its derivative. Elementary functions and their inverses. Fundamental theorems of differential calculus. Extremal values, existence. The main value theorem. Increasing and decreasing functions. Curve sketching. The indefinite integral. Upper and lower sums. Fundamental theorems and basic properties. Inequalities. Improper integrals. Substitution, integration by parts. Applications: length, area and volume. Work and moments. Taylor's formula. Differentiation of vector-valued functions. Differentiable curves. Ordinary differential equations. Linear differential equations, Fundamental solutions, Wronskian and linear independence.

Compulsory/Recommended Readings:

Howard A.: Calculus with analytic geometry, John Wiley and Sons, New York, 1989.
Lang S.: A First Course in Calculus, Springer, 1986.
Mendelson E.: 3,000 Solved Problems in Calculus, McGraw-Hill, 1988.

Subject: TMBE0604 Mathematics 2
Classes/week: 4 hour lecture, 2 hour seminar
ECTS Credit Points: 6
Prerequisites: TMBE0603 Mathematics 1
Lecturer: Péter T. Nagy, DSc

Topics: Functions of several variables, partial derivatives, Jacobian. Differentiability and gradient. Taylor's formula, estimate for the remainder. Critical points, relative maximum and minimum. Stationary point, second derivative test. Multiple integrals, applications: surface area, centers of gravity. Line integrals, independent of paths, Green' theorem. Surface integrals, divergence theorem, Stokes' theorem. Examples for partial differential equations. Discrete probability distributions, continuous density functions. Discrete and continuous conditional probability, paradoxes. Important distributions and densities. Expected value. Discrete and continuous random variables. Law of large numbers. Central limit theorem. Elements of mathematical statistics.

Compulsory/Recommended Readings:

Howard A.: Calculus with analytic geometry, John Wiley and Sons, New York, 1989.
Lang S.: A First Course in Calculus, Springer, 1986.
Mendelson E.: 3,000 Solved Problems in Calculus, McGraw-Hill, 1988.
Feller W.: An Introduction to Probability Theory and its Applications, John Wiley and Sons, New York, 1950.

Subject: TMBE0605 Mathematics 3
Classes/week: 4 hour lecture, 2 hour seminar
ECTS Credit Points: 6
Prerequisites: TMBE0604 Mathematics 2
Lecturer: Péter T. Nagy, DSc

Topics: Complex differentiability. The Cauchy-Riemann equations. Power series, analytic functions. Integrals over paths, Cauchy's theorem. Laurent series. The residue formula. Spaces of integrable functions. Fourier series, their complex form. Classical bases in function spaces. Elements of functional analysis. Hilbert spaces. Linear functionals and operators. Fourier transformation and its applications. Laplace transformation and its applications.

Compulsory/Recommended Readings:

Lang S.: Complex Analysis, Springer, New York, 1985.

Szőkefalvi-Nagy B.: Introduction to real functions and orthogonal expansions, Akadémiai Kiadó, Budapest, 1964.

Subject: TFBE1101 Physics 1
Classes/week: 3 hour lecture, 1 hour seminar
ECTS Credit Points: 5
Prerequisites: None
Lecturer: András Demény, PhD; Darai, PhD; Ferenc Cserpák, PhD

Topic: Physical concepts and quantities, systems of units. Description of motion of point particle. The concepts of mass and moment, the conservation of moment. Newton's laws, force laws and their simple applications: throws, harmonic motions. The Galilei principle, inertial forces. The law of angular momentum, conservation of angular momentum. Equilibrium of rigid bodies. The concepts of work and kinetic energy, the theorem of work. Potential energy, conservation law of mechanical energy. Elastic bodies, Hooke's law, elastic strength. Statics of liquids and gases. Stream of fluids, the equation of continuity, the Bernoulli's law and its application. Elastic waves, propagation, basic wave phenomena. The concept of temperature, temperature scales; equations of states. Interpretation of internal energy, the 1^{st} law of the thermodynamics, specific heat. Reversible and irreversible processes. Heat engines and refrigerators. The 2^{nd} law of the thermodynamics. Experiences on molecular structure of matter; Dalton's laws, Avogadro's law, Brownian motion. Potential energy of molecular interaction, surface tension, capillarity. The kinetic model of gases. The concept of probability distribution, the Maxwell-Boltzmann distribution. The concept of statistical weight. Statistical interpretation of entropy; free energy and free enthalpy. Phase transitions, chemical potential. Transport phenomena: diffusion, osmosis, heat conduction, viscosity.

Compulsory/Recommended Readings:

Halliday, Resnick, Krane: Physics, John Wiley & Sons Inc.
Sears, Zemansky, Young: University Physics, Addison-Wesley Publishing Company.

Subject: TFBE1102 Physics 2
Classes/week: 3 hour lecture, 1 hour seminar
ECTS Credit Points: 5
Prerequisites: TFBE1101 Physics 1, TMBE0603 Mathematics 1
Lecturer: Prof. Dr. József Pálinkás; Imre Szalóki, PhD

Topics: Basic concepts and phenomena of electrostatics. Electric charge, force between charges. Coulomb's law. Electric charge and matter. The concept of electric field. Gauss's law. Electrostatic potential. The electric dipole moment, the electric field of a system of charges, the principle of superposition. Conductors and insulators. Capacitance and capacitors. Energy density of the electrostatic field. Electric current and electric resistance, current density. Resistivity and conductivity. Ohm's law. Electronic circuits, the electromotive force. Kirchhoff's rules, an RC circuit. The mechanism of the electronic conduction of solids, liquids and gases. The concept of the magnetic field and the definition of magnetic field inductance vector. Magnetic force acting on a current or a moving charge. The magnetic field induced by a current or a moving charge Biot–Savart's and Amper's law. Magnetic properties of matter. Dia-, para- és ferromagnetic materials. Motion of charged particles in electric and magnetic field, mass spectrometers and particle accelerators. Faradays law of induction. The properties of the induced electric field, self induction, RL circuits. Energy stored in the magnetic field. Electromagnetic oscillations. Free and damped oscillations in LC and RLC circuits, forced oscillations, coupled oscillations, resonance. Alternating current circuits. Motors and generators, the transformer. The concept of displacement current and induced magnetic field. The Ampere-Maxwell law, Maxwell's equations. Electromagnetic waves. The properties and propagation of light, emission and absorption of light. The light as an electromagnetic wave. The diffraction of light on a slit, on double slits and on optical gratings. The propagation of light in materials, absorption and scattering. The light and the quantum mechanics; the properties of thermal radiation, Planck's law, the photoelectric effect, the concept of the photon. The Compton effect and the spectral lines of atoms. The wave properties of material particles, material waves. The Heisenberg uncertainty principle. The Schrödinger equation, the quantum sates of simple systems. The structure of the atom. The Thompson model. The Rutherford experiment. The Bohr/Rutherford model of the atom. The simple quantum mechanical model of the Hydrogen atom. The quantum numbers. The spin of the electron. The characteristic x radiation. The Pauli principle and the structure of many electron atoms. Spontaneous and induced emission light, and the laser effect. Chemical bonds. The electronic properties of solids, band structure and quantum statistics. Contact and thermoelectric phenomena. Electric current in semiconductors. Superconductivity. The discovery of the atomic nucleus. Radioactivity. The effect and measurement of radioactive radiation. Cosmic rays.

The properties and structure of the atomic nuclei. Nuclear models. Nuclear fission and fusion. Energy from the nuclei, nuclear reactors. Elementary particles and fundamental interactions. The basic principles of cosmology.

Compulsory/Recommended Readings:

Halliday, Resnick, Krane: Physics, John Wiley & Sons Inc.
Sears, Zemansky, Young: University Physics, Addison-Wesley Publishing Company.

Subject: TFBE1103 Materials Science for Electrical Engineering
Classes/week: 3 hour lecture, 1 hour seminar
ECTS Credit Points: 5
Prerequisites: None
Lecturer: Sándor Kökényesi, DSc

Topics: Systematization of materials, interconnections between the composition, structure, technology and properties. Structure of materials: elementary particles, atoms, periodical system. Chemical bonds, crystalline structure, defects, polycrystalline and amorphous materials. Mechanical, electrical and optical characteristics of materials. Metals and alloys, their technology and applications in electronics. Semiconductors: types, band structure, electron-hole conduction, applications. Dielectrics: conductivity, polarization, dielectric losses. Insulators in electronic technology. Magnetic materials. Special functional materials, superconductors, nanostructures.

Compulsory/Recommended Readings:

Van Vlack L.: Elements of Materials Science and Engineering, Addison-Wesley Publishing Co.
Callister W.D.: Materials Science and Engineering: An Introduction, 7th ed., John Wiley & Sons Inc., 2006.
Callister W.D.: Materials Science and Engineering: An Introduction, Student Problem Set Supplement, 6th ed., John Wiley & Sons Inc., 2005.
Functional Materials and Devices, edited by Arof A.K., Hashim Ali S.A., Trans Tech Publications, 2006.

Subject: TFBE1104 Introduction to Informatics
Classes/week: 2 hour lecture, 2 hour laboratory
ECTS Credit Points: 4
Prerequisites: None
Lecturer: András Bölcskei, PhD; Dr. habil Sándor Sudár, PhD

The goal of the course: to give to the students basic knowledge on computer usage and to lay the foundation for admission possibility of further subjects.

Topics: Computer as information-processing machine. Computer-architectures. Fundamental concepts of informatics (data, program, compiler, interpreter, programming, operating system, basic software, system software, application software, bit, byte, compatibility, syntax, semantics, programming languages, word- and table-processors, database management systems). Peripheral devices, their usage. Basic concepts of operating system. Concept, characteristics and specification modes of algorithm. Radix number systems, conversion rules. Information presentation in computers (address, presentation and operation performing with logic, numerical and textual data, presentation of programs). Basic principals of CPU function. Programming of computers. Basic principals of machine language programming. Assembly and high level languages. Basic algorithms (sort, search, merge). Basic concepts of computer networks. Development steps of computer systems. During practical classes the students will become familiar with the main elements of one operation system, one user interface and one word processor.

Compulsory/Recommended Readings:

Brookshear J. G.: Computer Science: An Overview, 7th edition. Addison Wesley, 2003.
L. Snyder: Fluency with Information Technology: Skills, Concepts, and Capabilities. Addison Wesley, 2004.

Subject: TFBE1105 Computer Architectures
Classes/week: 2 hour lecture, 3 hour laboratory
ECTS Credit Points: 5
Prerequisites: TFBE1104 Introduction to Informatics
Lecturer: Sándor Misák, PhD

The goal of the course: Students acquaint with PC, more complex computer systems and with physical and mathematical fundamentals of basic hardware devices, become familiar with CPU-around computer units (memory, main peripherals), look in their structure and function basics, obtain knowledge in computer organizational hierarchy and the future of computer hardware.

Topics: Concepts of basic hardware, computer grouping, computer generations. Organization of computer systems: CPU (processor), primary and secondary memory, input/output (I/O). Digital logic level: gates, Boole-algebra, basic digital logic circuits, memories, processors, buses. Microstructure architecture: data path, microinstructions, microinstruction control, design of microlevel architecture, examples, performance increase. Instruction set architecture: overview, instruction formats, data and instructions types, addressing, flow of control, Intel IA-64 architecture. Operating system level machine: virtual memory, virtual I/O instructions, virtual instructions for parallel processing. Assembly language level: introduction, macros, Assembly processing, linkage and load. Parallel computer architectures: design problems, SIMD-computers, distributed shared memory multiprocessors, message passing multicomputers. State of the modern microelectronics, difficulties, newest achievements. The future of computer hardware (optical, neural, nanocomputers).

Compulsory/Recommended Readings:

Tanenbaum, A. S.: Structured Computer Organization, 5th ed. New York: Prentice Hall, 2006.
Mueller S.: Upgrading and Repairing PCs, 11th ed. Indianapolis: Que, 1999.
Norton P., Goodman J.: Peter Norton's Inside the PC, 7 ed. Indianapolis: Sams Publishing, 1997.
Cady F.M. Microcontrollers and microcomputers: Principles of software and hardware engineering, 1st ed., New York: Oxford University Press, 1997.

Subject: TTBE0141 Introduction to Chemistry
Classes/week: 2 hour lecture
ECTS Credit Points: 3
Prerequisites: None
Lecturer: Sándor Kéki, PhD

The goal of the course is to give a basic knowledge in general and inorganic chemistry for advanced studies.

Topic: Material systems. The states of matter and phase changes. Spontaneous processes. The bases of thermochemistry. General characterization of equilibria. Homogeneous equilibria: Acids and bases, the fundamentals of pH-calculations, redox-equilibria, the formation and characteristics of complexes. Heterogeneous equilibria: The process of dissolution and the properties of solutions, distribution equilibria between two solvents, adsorption of gases and liquids. The bases of kinetics. Basic nuclear chemistry. The structure of atoms: The quantum description and the quantum numbers. The electron structure of atoms and the periodic table of elements. Periodic properties: Ionization energy, electronaffinity and electronegativity, the size of atoms and ions. The types of chemical bonds and their characterization. The occurence and abundance of elements. The most important elements and their compounds of high practical importance.

Compulsory/Recommended Readings:

McMurry J., Fay R.C.: Chemistry, 4th ed., New Jersey: Pearson Education International, Inc., Prentice Hall, 2004 (ISBN 0-13-121631-7).

Subject: TFBE0040 Fundamentals of Environmental Science
Classes/week: 1 hour lecture, 1 hour seminar
ECTS Credit: Points: 2
Prerequisites: None
Lecturer: Gyula Lakatos, PhD

Aim: Students can acquire the basic terms and gain insight into the sub-fields of environmental science; the presentation of the most important tasks of environmental protection

Topics: The definition and the elements of the environment. Man and his environment. Inter-, multi- and transdisciplinar characteristics of environmental science. The history of human activity on the environment, its effects and consequences, the environmental crisis.
The definition and scope of environmental protection. The history of environmental protection and conservation, global problems of the environment. The elements of natural environment, the ground, the waters and the atmosphere. Organization of living resources, basic ecology. The evolution of the biosphere, human population.
System-based approach in environmental science. Environmental resources and their protection. Environmental conferences, the message of Rio and its documents. Agenda 21, the conclusions of Johannesburg and their aspects in Hungary.
Environmental pollution and its effect, environmental protection as a human-centered social activity. Ecological approach focusing on life, the principles of sustainable development in environmental protection

Compulsory/Recommended Readings:

Jackson A.R.W., Jackson J.M. Environmental Science. The natural environment and human impact. Longman, Singapore, 1996.

Subject: TFBE1108 Economics
Classes/week: 2 hour lecture
ECTS Credit: Points: 3
Prerequisites: None
Lecturer: Imre Egri, PhD

Aim: To introduce students to the basic context and terminology of economy at macro- and micro level, so that they become able to realize economic processes and relationships.

Topics: Micro-economy. Actors of micro-economy. Households. Non-profit sector. Public utilities, enterprises. Consumer behaviour and demand. Producer behaviour and supply. Measuring in economy. Money. Market. The micro-economy of production. Expenditure, spending, revenue, income. Analysis of production factors. Capital, labour force.
Macro-economy. Context of economy. Indicators of national economy. Processes of reproduction. State roles. The tools and mechanism of economic management. Unemployment and inflation. The role of investments and savings in national economy. Financial sector. International economic integration. The European Union. International financial processes. Globalization.

Compulsory/Recommended Readings:

Samuelson P.A., Nordhaus W.D.: Economics, 18th edition, Academic Internet Publishers Inc., 2006.

Subject: TFBE1109 Introduction to the EU
Classes/week: 2 hour lecture
ECTS Credit: Points: 3
Prerequisites: None
Lecturer: István Süli-Zakar, DSc

Aim: After the introduction of the integration theory, students gain insight into the history of the EU and its role in world economy.

Topics: Institutions of the EU and the reform processes. Enlargement, the peculiarities of the fifth round of enlargement. Hungary in the EU

Compulsory/Recommended Readings:

Dinan D.: Ever Closer Union: An Introduction to European Integration (European Union), 2nd edition, Boulder: Lynne Rienner Publishers, 1999.
Nugent N.: The Government and Politics of the European Union, 6th edition, Palgrave-Macmillan, 2006.
Hix S., Noury A.G., Roland G.: The Political System of the European Union, 1st edition, Cambridge: Cambridge University Press, 2007.

Subject: TFBE1110 Fundamentals of Civil Law
Classes/week: 2 hour lecture
ECTS Credit: Points: 3
Prerequisites: None
Lecturer: György Csécsy, PhD

Aim: To introduce students to the basic rules of civil law, which is part of our every day life, and to the basic institutions of civil substantive law

Topics: Terms and basic principles of civil law (cooperation, good faith behaviour, and prohibition of abuse of rights). Legal facts. Rights of individuals. General approach of legal persons, common rules (legal nature, formation, representation, revocation). Companies. The definition and concept of property rights. The formation of shared ownership. Common rules of contracts. Principles of contract law (with respect to contractual freedom). Formation and performance of contract.
System of contractual guarantees. Delays. Failure in performance, sanctions, guarantees.
Conditions of civil liability. General rules, special responsibility patterns.

Compulsory/Recommended Readings:

Dunham W.C., Young R.D., Bockrath J.T.: Contracts, Specifications and Law for Engineers, 4th edition, McGraw-Hill Education, 1986.

Subject: TFBE1111 Economics of Enterprises
Classes/week: 4 hour lecture
ECTS Credit: Points: 4
Prerequisites: TFBE1108 Economics
Lecturer: Imre Egri, PhD

Aim: Introduction to the operation of enterprises in practice. Preparation of investments, registration, business planning.

Topics: Examining enterprises. Methods to describe enterprises. Performance of enterprises. Business performance, monetary performance, extraordinary performance. Development of enterprises. Investments at company level.
Preparation of investments, feasibility studies. Analysis of investments. Static and dynamic methods of analysis. Registration, book-keeping.
Public procurement. Certification and accounting of economic operations. Rules of invoicing. Balancing, inventory. Accrual-based accounting, tax-paying obligations. Laws regulating the taxation system. Types of taxes on enterprises. Corporation tax and capital return tax. Value added tax, personal income tax.
Making business plans.

Compulsory/Recommended Readings:

Miller D.S., Catt S.E., Carlson J.R.: Fundamentals of Management, South Western College Publishing, 1996.
Lussier R.N.: Management Fundamentals, 2nd edition, South Western College Publishing, 2002.
Mohanty S. K.: Fundamentals of Entrepreneurship, Prentice-Hall of India Pvt. Ltd., 2005.
Steinhoff D., Burgess J.F.: Small Business Management Fundamentals, 6th edition, McGraw-Hill Education, 1992.
Friend G., Zehle S.: Guide to Business Planning, Economist Books, 2004.

Subject: TFBE1112 Intellectual Property Protection
Classes/week: 2 hour lecture, 1 hour seminar
ECTS Credit: Points: 3
Prerequisites: TFBE1110 Fundamentals of Civil Law
Lecturer: Imre Mojzes, DSc

Aim: The course provides an introducing to the filed of intellectual property rights, know-how, patents, copyright issues from the perspective of the engineering profession.

Topics: The basics of intellectual property rights from the perspective of an engineer: manading ones own intellectual properties. Basic documents and laws related to intellectual properties. Industrial property, which includes inventions (patents), trademarks. The usage of intellectual property related database. International law related to industrial intellectual property protection: PCT and the European union. The special aspects of software related intellectual properties in Hungarian and international perspective.

Compulsory/Recommended Readings:

Junghans C., Levy A., Sander R., Boeck T., Heerma J.D., Regierer Ch.: Intellectual Property Management: A Guide for Scientists, Engineers, Financiers, and Managers, Wiley-VCH, 2006.
Intellectual Property: A Guide for Engineers: By the American Bar Association. ASME Press, 2001.
Intellectual Property: A Guide for Engineers, SPIE Society of Photo-Optical Instrumentation Engineers, 2001.
Irish V.: Intellectual Property: A Guide for Engineers, Institution of Engineering and Technology, 1993.
Lewelyn D.: Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights, Sweet & Maxwell, 2003.
Gordon T.T., CookFair A.S.: Patent Fundamentals for Scientists and Engineers, 2nd edition, CRC Press Inc., 2000.
Handbook of industrial property rights: Hungarian Patent office.

Subject: TFBE1201 Programming 1
Classes/week: 2 hour lecture, 4 hour seminar
ECTS Credit Points: 6
Prerequisites: None
Lecturer: Sándor Misák, PhD; Ferenc Kun, PhD

The goal of the course: Students acquaint with C programming language, become familiar with basic algorithms and programming techniques.

Topics: principals of machine data processing: computer organization, batch-processing, multiprocessing, time-sharing, personal, distributed, server/client computations, structural programming, basic principals of C environment. Introduction to C programming language: basic concepts of computer memory, examples of simple programs. Structural program development: algorithms, flow control statements (selection, repetition), branches, loops. Functions: program components, math library functions, definition and declaration of function, storage classes, pass arguments to functions (pass-by-value and pass-by-reference), recursion. Arrays and vectors: declaration, passing arrays to functions, sorting, searching, multidimensional arrays. Pointers: declaration, initialization, pointer operators, passing arguments to functions by reference with pointers, relationship between pointers and arrays, arrays of pointers. Characters and strings: declaration, character handling library, functions of string handling library. Formatted input/output: streams, printf/scanf functions. Structures, unions, bitwise operators, ordinal constants. File processing: data hierarchy, files and streams, sequential and random-access files. Self-referential data structures: dynamic memory allocation, linked lists, stacks, queues, trees. Preprocessor directives.

Compulsory/Recommended Readings:

Kernigan B. W., Ritchie D M.: The C programming language, 2nd ed. Bell Telephone Laboratories, Incorporated, 1988.
Deitel H. M., Deitel P. J.: C How to Program, 4th ed. Prentice Hall, 2004.
Harbison S., P. Steele G. L., Jr. C: A Reference Manual, 5th ed. Prentice Hall, 2002.
Perry G.: Absolute Beginner's Guide to C, 2nd ed., USA: SAMS Publishing, 1994.

Subject: TFBE1202 Programming 2
Classes/week: 2 hour lecture, 4 hour seminar
ECTS Credit Points: 6
Prerequisites: TFBE1201 Programming 1
Lecturer: Sándor Misák, PhD; Ferenc Kun, PhD

The goal of the course: Students acquaint with C++ programming language.

Topics: Introduction to C++ programming language: introduction to classes and objects, control statements, functions, arrays and vectors, pointers and pointer-based strings. Deeper look to classes, data abstraction and information hiding, operator overloading. Object-oriented programming: polymorphism, inheritance. Templates, stream input/output, exception handling, file processing. Web programming, searching and sorting, data structures, bits, characters, structures. Standard Template Library (STL).

Compulsory/Recommended Readings:

Deitel H. M., Deitel P. J.: C++ How to Program, 5th ed. Prentice Hall, 2005.
Stroustrup B. The C++ Programming Language (Special Edition), USA: Addison Wesley. Reading Mass. 2000.
Schildt H. C++: A Beginner's Guide, 2nd ed., USA: McGraw-Hill/Osborne, 2004.
Schildt H. C++: The Complete Reference, 4th ed., USA: McGraw-Hill/Osborne, 2003.

Liberty J., Jones B. SAMS Teach Yourself C++ in 21 Days, 5th ed., USA: Sams Publishing, 2005.

Subject: TFBE1203 Measurements and Instrumentation 1
Classes/week: 2 hour lecture, 3 hour laboratory
ECTS Credit Points: 5
Prerequisites: TFBE1101 Physics 1
Lecturer: Dr. Imre Szalóki, PhD; Dr. Ferenc Cserpák, dr. univ.

Topics: Introduction to the measurement and instrumentation, models and modeling. International System of Units (SI). Methods and uncertainties of the measurements; general structure of the instruments; current and voltage measurements; different type of the current and voltage measurement (integrating DC measurement, absolute, RMS, vector, selective measurement equipments). Signal processing and noise. Signal transducers (RLC circuits, dividers, PWM divider, etc.). Measurement amplifiers, rectifiers, RMS-transducers, sampling and hold units, DA and AD converters. Digital multimeters.

Compulsory/Recommended Readings:

Reissland M.U.: Electrical Measurements: Fundamentals, Concepts, John Wiley & Sons Inc., 1989.
Berlin H.M., Getz F.C.: Principles of Electronic Instrumentation and Measurement, Charles Merrill, 1988.
Northrop R.B.: Introduction to Instrumentation and Measurements, 2nd edition, CRC Press Inc, 2005.
Bell D.A.: Electronic Instrumentation and Measurements, new edition, David Bell, 2007.
Wolf S., Smith R.F.M.: Student Reference Manual for Electronic Instrumentation Laboratories, Pearson US Imports & PHIPEs, 1997.

Subject: TFBE1204 Measurements and Instrumentation 2
Classes/week: 2 hour lecture, 3 hour laboratory
ECTS Credit Points: 5
Prerequisites: TFBE1203 Measurements and Instrumentation 1
Lecturer: Dr. Imre Szalóki, PhD; Dr. Ferenc Cserpák, dr. univ.

Topics: Power and energy measurements; determination of impedances; time and frequency measurements; sources and loads; signal analyzers; calibration of the instruments. Computer controlled measurements; unified connection systems; data transfer modes between the computers and measuring equipment, communication procedures; programming languages, programming tools.

Compulsory/Recommended Readings:

Runyan W.R., Shaffner T.J.: Semiconductor Measurements and Instrumentation, 2nd edition, McGraw-Hill Publishing Co., 1998.
Webster J.G.: The Measurement, Instrumentation and Sensors Handbook (Electrical Engineering Handbook Series), CRC Press Inc., 1998.
Northrop R.B.: Introduction to Instrumentation and Measurements, 2nd edition, CRC Press Inc, 2005.
Wolf S., Smith R.F.M.: Student Reference Manual for Electronic Instrumentation Laboratories, Pearson US Imports & PHIPEs, 1997.

Subject: TFBE1205 Electricity
Classes/week: 4 hour lecture, 2 hour seminar
ECTS Credit Points: 6
Prerequisites: TMBE0604 Mathematics 2, TFBE1102 Physics 2
Lecturer: Dr. habil Sándor Sudár; Endre Takács, PhD

Purpose: In depth study of the laws of Electrodynamics previously introduced in Physics 2. Selected subjects related to the profession of Electrical Engineering.

Topics: Basic laws of electrodynamics, electric charge, electric current, field quantities. Differential and integral forms of the Maxwell equations. The division of electrodynamics according to the Maxwell equations. Static and stationary fields. Electric potential, Poisson equation, electric field of a dipole. Electrostatics of conductors, capacitors, energy stored in capacitors. Continuity equation, differential and integral forms of Ohm's law, Kirchoff's

laws, Thévenin and Norton substitutions. Analysis of DC circuits, simple circuits, graph model of complex circuits, bipoles. Structure and analysis of complex circuits, method of lop currents, method of junction potentials. Circuits of connected bipoles. Full and reduced network equations. Principle of superposition. Junction and loop analysis. Regularity of networks. Substituting generators. Calculation of static magnetic fields, magnetic loops, inductivities. Electromagnetic waves. Wave equation. Energy balances, Poynting vector. Boundary conditions, retarded potentials. Elementary radiating dipoles. Plane waves in ideal insulators and conductors. Waveguides, cavity resonators. Methods of calculation of electromagnetic fields. Calculation of forces. Eddy current phenomena. Transmission lines. Telegraph equations. Solutions for sinusoidal excitations, interpretation of solutions. Closed end transmission lines. Transmission lines as bigates.

Compulsory/Recommended Readings:

Hammond P.: Electromagnetism for Engineers: An Introductory Course (Textbooks in Electrical & Electronic Engineering), 4th ed., Oxfor University Press, 1997.
Schwarz S.E.: Electromagnetics for Engineers, Oxford University Press Inc., USA, 1999.
Howatson A.M.: Electrical Circuits and Systems: An Introduction for Engineers and Physical Scientists (Textbooks in Electrical & Electronic Engineering), Oxford University Press, 1996.
Griffiths D.: Introduction to Electrodynamics, Prentice-Hall International Inc., Upper Saddle River, New Jersey.
Jackson J.D.: Classical Electrodynamics, John Wiley and Sons Inc., New York.

Subject: TFBE1206 Networks and Systems
Classes/week: 4 hour lecture, 2 hour seminar
ECTS Credit Points: 6
Prerequisites: TMBE0605 Mathematics 3
Lecturer: Dr. habil Sándor Sudár; Endre Takács, PhD, Sándor Egri

The goal of the course: The course provides the basic idea and calculation methods of the networks and system with concentrated elements.

Topics: Networks of sinusoidal signals, Kirchhoff's laws for time variant networks, Calculation of the electric power for sinusoidal signals. Capacitor, inductor, coupling. Network equations. Initial and boundary values. Methods of the solution. Free and excited component of the solution. First and second order networks. Dirac impulse. Impulse response and its applications. Unit sample response. Excitation – answer stability. Describing sinusoidal signals with its phasor. Complex characteristic of the network elements. Powers, calculation networks with sinusoidal excitations. Equivalent generators. Power matching. The transfer characteristic and its representation by the Nyquist- and Bode-plot. Fourier-series form of forced response to periodic excitation. Spectral representation of signals. Bandwidth of the signal and distortion less signal transfer. Band-limited signals, sampling. Laplace transforms and its inverse. Transfer function. Response calculation in the complex frequency range by Laplace transformation. Nonlinear resistive networks.

Compulsory/Recommended Readings:

Edminister J.A., Nahvi M.: Schaum's Outline of Theory and Problems of Electric Circuits, McGraw-Hill Professional, 2003.
Wai-Kai Chen: Linear Networks and Systems: Algorithms and Computer-Aided Implementations, World Scientific, 1990.
Nilson J.W.: Electric Circuits, Addison-Wesley, 1990.
Wai-Kai Chen: Broadband Matching: Problems & Solutions, World Scientific, 1993.

Subject: TFBE1207 Electronics 1 (Electronic Devices)
Classes/week: 3 hour lecture, 1 hour seminar
ECTS Credit Points: 5
Prerequisites: TFBE1102 Physics 2
Lecturer: Sándor Misák, PhD

The goal of the course: Students acquaint with structure, function and application areas of electronic devices.

Topics: electronics definition, devices categories, passive and active, linear and non-linear, vacuum and solid-state devices definition. Fundamentals of semiconductor electronic devices function on the basis of band structure theory. Conduction mechanisms, work function of metals, thermo- and photoelectric emission in vacuum. Passive elements: conductors, resistors, temperature-dependent effects, thermistors, varistors, capacitors, coils, transformers. Passive

elements in hybrid and monolith design: thick-, thin-layer, and Si technology. Semiconductors, equilibrium and non-equilibrium charge carriers distribution, transport processes, mobility. p-n junction: band structure, function, characteristics, switching diodes, avalanche diode, photodiode, photocell, Gunn-diode, tunnel diodes. Bipolar transistors: function, static characteristics, transistor models, low- and high-frequency function. Unipolar devices: metal-semiconductor contacts, function of junction field-effect transistor (FET), MOS-diode capacitance, surface states, inversion, space dependency of mobility. Function principles of MOSFETs, characteristics, models. Switching function, integrated applications: n-MOS, p-MOS, c-MOS, BICMOS. Thyristor, triac as solid-state power-switching elements. Optoelectronic devices: LED, semiconductor laser, photodiode, phototransistor, optocoupler, displays. Microwave generator-tubes, klystron, wave tubes, magnetron. Cathode-ray tubes (CRTs), photoelectron multiplier. Noise in electronic devices, shot noise, thermal and generation/recombination noise.

Compulsory/Recommended Readings:

Sze S.M.: Semiconductor Devices: Physics and Technology, 2nd ed., New York: Ed.-Wiley, 2002.
Van Zeghbroeck B.: Principles of Semiconductor Devices, 2004. (web address: http://ece-www.colorado.edu/~bart/book/book.html).
Wang F.F.Y. Introduction to solid state electronics. Amsterdam; New York: North-Holland; New York, NY, USA: Sole distributors for the USA and Canada, Elsevier Science Pub. Co., 1989.

Subject: TFBE1208 Electronics 2 (Analog Electric Circuits)
Classes/week: 3 hour lecture, 2 hour laboratory
ECTS Credit Points: 5
Prerequisites: TFBE1207 Electronics 1.
Lecturer: Imre Zolomy, DSc; Sándor Misák, PhD; Lajos Harasztosi

The goal of the course: Students acquaint with structure, function, characteristics of some important analog circuits.

Topics: passive RL, RC, RLC circuits, filters, oscillatory circuits. Rectifiers. Basic bipolar transistor schemes, characteristics, four-pole equivalent circuits. Basic field-effect transistor schemes, characteristics, four-pole equivalent circuits. Transistor current generator, current mirror. Multistage amplifiers, feedback. Transistor differential amplifier. Basic schemes with operational amplifiers. Oscillators: conditions of oscillation self-excitation in oscillators, RC, LC oscillators, xtals. Function generators: structure, output signals, different types (triangular, rectangular pulse generator, sinus generator, ramp generator, etc.). Power supplies, stabilizers, integrated voltage regulators. Power amplifiers, complementary emitter follower, setting of transistor operation points, current limitation, AB class complementary emitter follower. Analog multiplier, divider and square-root forming circuits. Analog switches, electronic switches, sample-receiving and holding circuits. Controlled generators and impedance converters, negative impedance converters, gyrator, rotator. Principles of D/A, A/D conversion. D/A and A/D converters.

Compulsory/Recommended Readings:

Crecraft D.I., Gergely S. Analog electronics: Circuits, systems and signal processing, 1st ed., USA: Elsevier Science, 2002.
Tietze U., Schenk Ch.: Electronic circuits: Handbook for design and application, Berlin: Springer-Verlag Berlin, 2006.
Thompson M.T.: Intuitive circuit design, USA: Elsevier, 2006.
Dorf R. C.: Introduction to electric circuits, New York [etc.]: Wiley, 1989.
Horowitz P.: The art of electronics, 2nd ed., Cambridge University Press, 1989.
Nilson J.W.: Electric Circuits, Addison-Wesley, 1990.

Subject: TFBE1209 Digital Electronics 1
Classes/week: 3 hour lecture, 2 hour seminar
ECTS Credit Points: 5
Prerequisites: TFBE1202 Programming 2
Lecturer: Gyula Zilizi, PhD; Sándor Misák, PhD

The goal of the course: Students acquaint with structure, function, characteristics, design of some important digital circuits.

Topics: Concepts of logic network, classification of logic networks. Combinational networks presentation modes. Logic functions, truth table, logic schemes, Karnaugh-Veitch tables. Study and design of combinational networks.

Signal propagation delay time, combinational networks hazards. Typical combinational networks (multiplexers, demultiplexers, coding/decoding and shifting circuits, digital comparators). Programmable combinational networks. Concepts of sequential networks, classification of sequential networks, Moore and Mealy models. Synchronous and asynchronous networks. Storage elements, flip-flop types. Study and design of synchronous networks, state table, state equation, state diagram. Typical simple synchronous networks: counters and registers. Study and design of asynchronous networks.

Compulsory/Recommended Readings:

Horowitz P.: The art of electronics, 2nd ed., Cambridge University Press, 1989.
Predko M.: Digital electronics. Demystified: A self-teaching guide, 1st ed., USA: McGraw-Hill, 2004.
Bignel J.W., Donovan R., Donovan R.: Digital electronics, 4th ed., USA: Thomson Delmar Learning, 2000.

Subject: TFBE1210 Digital Electronics 2
Classes/week: 2 hour lecture, 4 hour laboratory
ECTS Credit Points: 5
Prerequisites: TFBE1209 Digital Electronics 1
Lecturer: Gyula Zilizi, PhD; Sándor Misák, PhD

The goal of the course: Students acquaint with some integrated digital circuit family, D/A and A/D converters, microprocessors and microcontrollers, design and simulation of digital circuits.

Topics: Main parameters of logic circuits. Invertors, TTL, MOS/CMOS, ECL, I^2L circuits. Bipolar transistor Totem-Pole output and some variants (opened collector, tri-state, Schmitt-triggered input, bus hold, transmission gate). Parameters, comparison and matching of circuit families. Noise in digital systems. Noise problems.

D/A and A/D converters. Arithmetic circuits. Arithmetic-Logic Unit. Digital semiconductor memories. Circuit parameters and characterization of microprocessors and microcontrollers. Fundamentals of digital microprocessor and microcontroller design. Design and simulation of digital circuits, their implementation and test by CAD program and FPGA circuits.

Compulsory/Recommended Readings:

Horowitz P.: The art of electronics, 2nd ed., Cambridge University Press, 1989.
Crisp J.: Introduction to microprocessors and microcontrollers, 2nd ed., Great Britain: Elsevier, 2004.
Tietze U., Schenk Ch.: Electronic circuits: Handbook for design and application, Berlin: Springer-Verlag Berlin, 2006.
Kleitz W. Digital electronics: A practical approach, 7th ed., USA: Prentice Hall, 2004.

Subject: TFBE1211 Electronic Technology
Classes/week: 3 hour lecture, 2 hour laboratory
ECTS Credit Points: 5
Prerequisites: TFBE1103 Materials Science for Electrical Engineering
Lecturer: Sándor Kökényesi, DSc

Topics: Basic technologies of microelectronics: laboratory and industry. Main types and technology of semiconductors: Si, GaAs, CdS and similar materials, their parameters. Technology of single crystals, polycrystals, amorphous materials. Thin films, heterostructures, nanostructures. Basic technologies: epithaxy, MBE, CVD, implantation, diffusion, vacuum- and laser-technologies. Lithography, selective etching. Parameters of materials and devices. Active and passive elements, diodes, transistors, circuits. Optoelectronic elements and devices. Quality , reliability. Some peculiar applications: sensors, solar cells, memory elements, functional electronics, mechatronics. Trends of the development in microelectronics.
At the laboratory students deal with thin film technology, lithography, fabrication of heterostructures, crystal growth, thin film measurements.

Compulsory/Recommended Readings:

Microelectronic Materials and Processes (NATO Science Series: E), edited by Levy R.A., Kluwer Academic Publishers, 1989.
Campbell S.A.: The Science and Engineering of Microelectronic Fabrication, 2nd edition, Oxford University Press Inc., 2003.

Bargon J.: Methods and Materials in Microelectronic Technology (IBM Research Symposia Series), Plenum Pub. Corp., 1984.
Gupta T.: Handbook of Thick- and Thin-film Hybrid Microelectronics, John Wiley & Sons Inc., 2003.

Subject: TFBE1212 Automation 1
Classes/week: 3 hour lecture, 1 hour seminar
ECTS Credit Points: 5
Prerequisites: TFBE1202 Programming 2, TMBE0605 Mathematics 3
Lecturer: Ruth Bars, PhD; István Bézi, dr. univ.

The goal of the course: Presenting the continuous time linear control systems, its analysis and synthesis.

Topics: The concept of control, systems and signals. The classification of signals. Control structures, regulation and control, compensation of disturbances. The structure of an automation control system. Examples, Main requirements of a control system.
Continuous time linear systems and terms. Modeling. State space description. The solution of the state space equation, self evolution, induced evolution, stability. State transformation. Controllability and observability. Kalman subsystems types. The principle of state feedbabck. Representative function of simple and composite systems.

The signal transfer properties of a feedback system. Composite transfer system types, base signal following and noise compensation. Stability analysis and the Nyquist staility criterion. Quality parameters of a regulatory system and their estimates base on the properties of the frequency space representation.

Methods of the control system design, Serial P, PD, PI and PID compensation, proportional and integral systems. Compensation with feedback. Dead-time compensation, Smith predictor. Noise compensation, cascade regulation.

Experimental setup of control systems. The Ziegler-Nicholson and the Oppelt method.

Computer based laboratory practices based on the MATLAB/SIMULINK program. Demonstration programs, solving control system analysis and synthesis problems.

Compulsory/Recommended Readings:

Norman S.: Noise Control Systems Engineering, John Wiley and Sons, 2003.
Franklin G. F., Powell J.D., Emami-Naeini A.: Feedback Control of Dynamic Systems, Prentice Hall, 2005.
Control systems. Computer practices, 2002.

Subject: TFBE1213 Automation 2
Classes/week: 3 hour lecture, 1 hour seminar
ECTS Credit Points: 5
Prerequisites: TFBE1212 Automation 1
Lecturer: Ruth Bars, PhD; István Bézi, dr. univ.

The goal of the course: Presenting discrete linear and nonlinear systems, synthesis and analysis.

Topics: Sampled regulatory systems. Discreet Laplace transformation. The Z transformation and its basic properties. Sampled transfer terms and its description in the time, operator and frequency domain. Control terms difference equations. Impulse transfer functions. Shannons sampling theorem. Low frequency approximation. Stability properties of sampled systems. Design of a discrete pole shift compensation (PID) algorithm. Design for finite setelling time.
Optimal, adaptive and robust control systems.

Nonlinear control systems. The method of picewise linearization at the working point. Typical nonlinearity types (saturation, sensitivity zone, hysteresis, etc.) and its effect on the linearly designed control circuit. Limiting cycles. Transfer function. Decreasing the sensitivity band of a servo motor. Tachometer feedback and position regulation. Position regulation, improving the regulation properties with feedback. Time proportional regulation. Saturation effects (wind-up) and its elimination. Regulator programming. Neural networks and fuzzy control.

Computer based laboratory practices based on the MATLAB/SIMULINK program. Demonstration programs, solving control system analysis and synthesis problems.

Compulsory/Recommended Readings:

Franklin G.F., Workman M.L., Powell D.: Digital Control of Dynamic Systems, Addison-Wesley, 1993.
Control systems. Computer practices, 2002.

Subject: TFBE1214 Telecommunication
Classes/week: 3 hour lecture, 1 hour seminar
ECTS Credit Points: 4
Prerequisites: TFBE1205 Electricity
Lecturer: József Molnár, PhD; István Szabó, PhD

The goal of the course: Introducing the most fundamental concepts of telecommunication systems, the theoretical foundation of their methods, and the development of the corresponding competences.

Topics: Fundamentals of random processes, filtering techniques. Communications channels and information theory fundamentals. Modulation: AM, FM, analog and digital, bandwidth, demodulation. The basics of radio transmission. Digital signal transmission. Communication networks. Wired and wireless signal transmission systems. Mobile cellular communication systems. Optoelectronic communication systems.

Compulsory/Recommended Readings:

O'Reilly J.J.: Telecommunication Principles (Tutorial Guides in Electronic Engineering), Van Nostrand Reinhold International, 1989.
Dunlop J., Smith D.G.: Telecommunications Engineering, 3rd edition, CRC Press Inc., 1998.
Goleniewski L., Jarrett K.: Telecommunications Essentials: The Complete Global Sources, 2nd edition, Addison-Wesley, 2006.

Subject: TFBE1215 Microelectronics
Classes/week: 3 hour lecture, 2 hour seminar
ECTS Credit Points: 6
Prerequisites: TFBE1103 Materials Science for Electrical Engineering
Lecturer: Imre Mojzes, DSc

The goal of the course: Students acquaint with structure, manufacturing and test of integrated circuits (ICs) made by different technology.

Topics: Formation of microelectronics: dielectric-based ICs, main characteristics of semiconductor-based ICs technology. Monolith circuit technology: deep structure formation by planar epitaxial method. MOS transistors, resistors, capacitors, bipolar devices formation and tests: lateral and vertical p-n-p transistors. Optoelectronic elements, logic gates formation and their characterization: invertors, gate circuits and flip-flops formation. Charge-coupling problems. MOS and CMOS memory elements. ROM, PROM, PAL and EPROM. Static and dynamic RAM cells, integration density and limitations of different technologies. Charge-coupled devices (CCDs) and their application: dynamic memory and image-resolving elements. Semiconductor light-modulating devices and their application for image generation. Application-specific ICs (ASIC). Elements of analog circuits: differential amplifier, current mirror, level-shifter, power amplifier, phase-adder. Hybrid ICs and their technology. Reliability and quality test of microcircuits.

Compulsory/Recommended Readings:

Sedra A.S., Smith K.C.: Microelectronic Circuits (Oxford Series in Electrical & Computer Engineering), 5th edition, Oxford University Press Inc., U.S., 2004.
Horenstein M.N.: Microelectronic Circuits and Devices, Prentice Hall, 1991.
Jaeger R.C.: Introduction to Microelectronic Fabrication: 5 (Modular Series on Solid State Devices), 2nd edition, Prentice-Hall, 2001.
Leaver K.: Microelectronic Devices, 2nd edition, Imperial College Press, 1997.
Pulfrey D.L., Tarr N.G.: Introduction to Microelectronic Devices, Prentice-Hall, 1989.

Subject: TFBE1216 Electric Power Systems
Classes/week: 3 hour lecture, 2 hour seminar
ECTS Credit Points: 5
Prerequisites: TFBE1205 Electricity
Lecturer: Lajos Daróczi, PhD; Béla Lőrincz

The goal of the course: To give fundamentals for the students about the production, transmission and distribution of the electric energy. Understanding operation and control of electric power systems.

Topics: General structure of electric power systems, one and three phase systems. Structure of power networks, transformations, symmetric three-phase systems. Equivalent one-phase circuit, generator, transformer, power transmission line, distribution lines, short circuit power, consumer.

Voltage drop and power ratio of the arm of network, load capacity, voltage profile. Short circuits. Primary lightning and over-voltage protection. Electric, mechanic and heating switch-on transients of switching gears. Electric discharges in dielectrics. Conversion of electric energy into heat. Aerial lines, cables. Low-voltage lines. Fundamentals of power engineering. Phase correction as the basic method of the reactive power management. Electric switching gears. Circuit breakers, indoor and outdoor switching gears. Control and protecting gears. Earthing systems. Physiological effects of magnetic and electric fields. Electric shock, electrostatic discharge, stroke of lightning. Electric breakdown of insulators. ESD protection.

Compulsory/Recommended Readings:

Wood A.J., Wollenberg B.F.: Power Generation, Operation, and Control, 2nd ed., Wiley, 1996.
Casazza J., Delea F.: Understanding Electric Power Systems: An Overview of the Technology and the Marketplace, Wiley, 2003.
Saccomanno F.: Electric Power Systems: Analysis and Control, Wiley, 2003.

Subject: TFBE1217 Production and Quality Management
Classes/week: 2 hour lecture, 3 hour laboratory
ECTS Credit Points: 5
Prerequisites: TFBE1215 Microelectronics
Lecturer: Imre Mojzes, DSc

The goal of the course: The description of industrial production processes and their relation to quality control. Introduction of the applicable ISO standards and their applications.

Topics: Experimental and full scale production methods. Sequential and parallel production techniques. Specific elements of the electronic industrial production. Logistics and production organization issues. Methods of documentation. Industrial production and standards. The ISO 9000 and ISO 14000 standard series on the example of electronic manufacturing. Green electronics.

During the practice periods, the students get acquainted with the standard practices at the National Instruments Factory especially with the steps related to quality control, application of automated test methods, laboratory techniques for product quality assessments (microscopic techniques, enhanced aging test etc.).

Compulsory/Recommended Readings:

Smith J., Whitehall F.B.: Optimizing Quality in Electronics Assembly: A Heretical Approach, McGraw-Hill Publishing Co., 1997.
Tricker R.L.: Quality and Standards in Electronics, Newnes, 1997.
Shinskey F.G.: Process Control Systems: Application, Design and Tuning, McGraw Hill Higher Education, 1996.
Hoyle D.: ISO 9000 Quality Systems Handbook, 5th edition, Butterworth-Heinemann Ltd., 2005.
The ISO 14000 Handbook, edited by Cascio J., McGraw-Hill Education, 1999.

Subject: TFBE1601 Photonics
Classes/week: 2 hour lecture, 2 hour laboratory
ECTS Credit Points: 4
Prerequisites: TFBE1215 Microelectronics
Lecturer: Imre Mojzes, DSc; Sándor Kökényesi, DSc; Sándor Misák, PhD

The goal of the course: Students acquaint with photonic materials, devices and some application aspects (optical communication, measurement technology, medical equipment).

Topics: Synthesis of photonic materials and devices (synthesis of monocrystals, epitaxial methods, implantation, diffusion, different lithographic methods). Different light-emitting diodes and epitaxial semiconductor laser. Solid-state lasers (ruby laser). Gas and dye lasers. Lenses and mirrors. Optical transmitters and detectors. Characteristics of light-guiding fiber. Quartz and plastics-based devices. Basic cases of application possibilities. Basic optical circuits.

Compulsory/Recommended Readings:

Saleh B.E.A., Teich M.C.: Fundamentals of Photonics (Wiley Series in Pure & Applied Optics), John Wiley & Sons Inc., 1991.
Liu Jia-Ming: Photonic Devices, Cambridge University Press, 2005.
Nalwa H.S.: Nandbook of Advanced Electronic and Photonic Materials and Devices, Academic Press Inc., U.S., 2000.
Prasad P.N.: Nanophotonics, John Wiley & Sons Inc., 2004.

Subject: TFBE1602 Nanotechnology
Classes/week: 3 hour lecture
ECTS Credit Points: 4
Prerequisites: TFBE1215 Microelectronics
Lecturer: Dezső Beke, Prof.

Aim: To show and illustrate the meaning and content of nanophysics, nanotechnics and nanotechnology. Describe the basics of most important nanotechnologies, those nanoscale processes on which the present and future technologies are based.

Topics: Production and characterization of thin films and multilayers. Nanoscale engineering, tailoring and characterization of surfaces. Mechanical stability and time of life of nanostructures. Spintronics (Tailoring and realization of devices based on spin-manipulations). Technologies of nanoparticle ensembles. Nanomagnetism. Nanodiffusion. Nanosegregation.

Compulsory/Recommended Readings:

Sidorenko S.I., Beke D.L., Kikineshi A.A.: Materials Science of Nanostructures (Ed. M.K. Pynina), Kyiv: Naukova Dumka, 2002.
Springer Handbook of Nanotechnology, edited by Bhushan B., 2nd edition, Springer Science, Vol.XLIV 2007.
Introduction to Nanoscale Science and Technology, edited by Di Ventra M., Evoy S., Heflin Jr. James R., Springer Science, 2004.
Dekker Encyclopedia of Nanoscience and Nanotechnology, edited by Schwarz J.A., Contescu C.I., Putyera K.: Taylor & Francis Group, 2004.
Wolf E.L.: Nanophysics ans Nanotechnology: An Introduction to Modern Concepts in Nanoscience (Physics Textbook), 2nd ed., Wiley-VCH, 2006.
Poole Ch.P., Owens F.J.: Introduction to Nanotechnology, Wiley-Interscience, 2003.

Subject: TFBE1603 Nanoelectronics
Classes/week: 3 hour lecture
ECTS Credit Points: 4
Prerequisites: TFBE1215 Microelectronics
Lecturer: Sándor Kökényesi, DSc

Topics: Main types of nanostructured materials, physical characteristics, technology: nanopowders, porouse materials, superlattices, quantum dots, wires, nanocomposites. Quantum effects in nanostructures, non-linear optical effects, peculiarities of electrical conduction. New light sources and detectors. Q-transistor, GMR-elements. Photonic crystals. Sensors. Integrated elements, development of atomic-size memory elements. New elements of information technologies, plasmonic structures. Nanostructures in biology , medicine and chemistry. Micro- and nano-devices, actuators.

Compulsory/Recommended Readings:

Bársony I., Kökényesi S.: Funkcionális anyagok és technológiájuk (Főiskolai jegyzet), Debrecen, 2003.
MATÁV and MTA Nanotechnology symposia (CD).

Nanotechnology and Nanoelectronics: Materials, Devices, Measurement Techniques, edited by Fahrner W.R., Springer Science, Vol.XVI, 2005.
Lundstrom M., Guo J.: Nanoscale Transistors: Device Physics, Modeling and Simulation, Springer Science, 2006.
Silicon Nanoelectronics, edited by Oda Sh., Ferry D., Taylor & Francis Group, 2005.
Goser K.: Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices, Springer, 2005.
Dragoman M., Dragoman D.: Nanoelectronics: Principles and Devices (Nanotechnology), Artech House Publishers, 2005.
Prasad P.N.: Nanophotonics, John Wiley & Sons Inc., 2004.
Current papers (nanotechweb.org, Materials Today, Nano Today).

Subject: TFBE1604 Digital Signal Processing and DSP processors
Classes/week: 1 hour lecture, 2 hour laboratory
ECTS Credit Points: 3
Prerequisites: TFBE1206 Networks and systems
Lecturer: István Szabó, PhD

The goal of the course: The course is introducing the basics of real time digital signal processing techniques with implementations on DSP processors.

Topics: DSP algorithms**:** Linear systems, Fourier series and Fourier transformation, Convolution and deconvolution, A/D converters, Digital filters, DFT-FFT, signal encoding and compression, DPS processors: typical architectures, addressing modes, instruction sets, memory models. Real time signal processing with DSP processors.

In the laboratory practices DSK sets are used to implement example problems: Introducing the programming environment, A/D-D/A conversion, FIR and IIR filter implementation and measurement, real time data compression: coding and decoding.

Compulsory/Recommended Readings:

Andreev Bateman, Iain Paterson-Stephens: The DSP Handbook Pearson Education, Harlow, England.
http://www.dspstore.com
Texas Instruments manuals: http://www.ti.com
Smith S. W.: The Scientists and engineers guide to Digital Signal processing (http://www.dspguide.com).

Subject: TFBE1605 Complex Design of Digital Systems
Classes/week: 2 hour lecture, 1 hour seminar
ECTS Credit Points: 4
Prerequisites: TFBE1212 Automation 1
Lecturer: Dr. habil István Ajtonyi

The goal of the course: Students master complex, EMC-focused design methods of electronic devices and apparatuses.

Topics: Five elements of successful design. Man-machine dialogue devices and their design. Design with regard of mechanical and environmental conditions. Grounding, shielding, filtering, protecting against electrostatic discharge. Circuit design and interface, signal delay, bounce, run-time, cross-talk, noise reduction, reflections. Circuit layout. Power supply, cooling, software, debugging and testing, validation and verification. Electromagnetic Compatibility (EMC) tests. EMC-focused design. Rapid prototyping, manufacturing and implementation.

Compulsory/Recommended Readings:

Fowler K.R.: Electronic instrument design: Architecting for the life cycle, USA: Oxford University Press, 1996.

Subject: TFBE1606 Materials Science Fundamentals of Information Technology
Classes/week: 2 hour lecture
ECTS Credit Points: 3
Prerequisites: TFBE1215 Microelectronics
Lecturer: Imre Mojzes, DSc

The goal of the course is to give an overview on materials and technologies used in info-communication devices and gears.

Topics: Wide range of materials from complex multilayer compound semiconductors to paper is used in IT devices. Parameters of these materials are usually the best because of used high-quality technology. Fast function rate, system complexity make high demands not only to the reliability of discrete elements but also to the technology. Besides the ergonomic aspects are also important for example in printing, displaying and sometimes in implementation of displays. Lectures acquaint with the fundamentals of above-mentioned materials and technologies.

Compulsory/Recommended Readings:

Mojzes I., Kökényesi S.: Fotonikai anyagok és eszközök, Budapest: Műegyetemi Kiadó, 1997.
Materials for Information Technology: Devices, Interconnects and Packaging (Engineering Materials and Processes), Zschech E., Whelan C., Mikolajick T., Springer, 2005.
Nanoelectronics and Information Technology: Advanced Electronic Materials And Novel Devices, edited by Waser R., Wiley-VCH, 2003.
Optical Properties of Condensed Matter and Applications (Wiley Series in Materials for Electronic & Optoelectronic Applications), edited by Singh J., Wiley, 2006.

Subject: TFBE1701 Electrical Machines and Drives
Classes/week: 2 hour lecture, 2 hour laboratory
ECTS Credit Points: 4
Prerequisites: TFBE1205 Electricity
Lecturer: Lajos Daróczi, PhD

The goal of the course: introducing students to the fundamentals of transformers, electric engines and propulsion systems. Understanding operation, control and service of these equipments.

Topics: Classification of energy-conversion equipments. Physical principles of transformers, induced voltage, construction, energy losses, open circuit, short circuit and loaded operation. Three-phase transformers. Fundamentals of rotating field theory and it's application. Synchronous machines: principle and structure of three-phase synchronous machines. DC machines: mechanic end electronic commutation. Three-phase asynchronous machines: principle and construction.

Compulsory/Recommended Readings:

Vas: Electrical Machines and Drives, Oxford, 1999.
Nasar: Electric Machines and Electromechanics, McGraw-Hill, 1981.

Subject: TFBE1702 Computer Controlled Measurement and Process Control
Classes/week: 2 hour lecture, 1 hour laboratory
ECTS Credit Points: 4
Prerequisites: TFBE1213 Automation 2
Lecturer: Dr. habil Sándor Sudár; Gyula Zilizi, PhD; László Oláh, PhD; Zoltán Szillási

The goal of the course: The course provides the basic idea of the computer controlled measurement and control.

Topics: Structure of measuring systems, basic elements of the measuring system. Evolution of the computer controlled measurements. Unified connection systems (CAMAC, IEC, etc.). Data transfer modes between the computers and measuring equipment, communication procedures. Computer operation systems and their effect on measurements. Realization of the computer controlled measurements in different programming languages, programming tools. Basics of the process control, type of the control systems. Processes control by computer. Examples for real measuring and process controller systems. Fuzzy logic, neural networks and theirs application in the process control.

Exercises: Introduction to LabVIEW, LabVIEW Virtual Instruments, Creating, Editing, and Debugging a VI, Creating a SubVI, Loops and Charts, Arrays, Graphs and Clusters, (Creating arrays, Waveform and XY Graphs), Case and Sequence Structures, Formula and Expression Nodes, Strings and File I/O (Build String VI, File I/O VIs and Functions, Formatting Spreadsheet Strings); Data Acquisition and Waveforms (Data Acquisition (DAQ) Overview, Organization of Data Acquisition VIs, Performing a Single Analog Input), DAQ Wizards, Waveform Analog Input, Writing Waveform Data to File, Scanning Multiple Analog Input Channels, Analog Output, Digital Input and Output, Counters;
Instrument Control Overview, GPIB Communication and Configuration.

Exercise for the I/O port handling. Making a computer controlled function generator by the D/A converters, amplitude and frequency control; Play back of digitally stored sound using D/A converter.

Compulsory/Recommended Readings:

Doebelin O.E.: Measurement Systems. Application and Design, New York: McGraw-Hill, 2004.
Kahler J., Frank H.: Fuzzy-Logic und Fuzzy-Control, VIEWEG, 1994.
Nørgaard M., Ravn O., Poulsen N.K., Hansen L.K.: Neural Networks for Modeling and Control of Dynamic Systems, London: Springer-Verlag, 2000.
Young Ho Kim, Lewis F.L.: High-Level Feedback Control With Neural Networks**,** World Scientific, 1999.
LabVIEW User Manual, National Instruments, 2003.
LabView Measurement Manual, National Instruments, 2003.

Subject: TFBE1703 Identification and Control Systems
Classes/week: 2 hour lecture, 1 hour laboratory
ECTS Credit Points: 4
Prerequisites: TFBE1212 Automation 1
Lecturer: Károly Szandtner, dr. univ.; Sándor Misák, PhD

The goal of the course: practical mastering with the structure and functioning principles, design and application of identification systems.

Topics: Devices suitable for invocation, reading and/or writing of data carriers. Some typical application examples on demonstration of identification and control systems. Identification and control systems based on emitting and measurement of optical signals. Application of loop-control implemented on power circuit for identification. Application of long-wave radiofrequency receiver-transmitter systems for identification and control purposes. Safeguarding equipments and systems. Fire-alarm equipments. Structure of building-informatics systems.

Compulsory/Recommended Readings:

Bowers D.M.: Access Control and Personal Identification Systems, Butterworth-Heinemann, 1988.
Intelligent Control Systems Using Soft Computing Methodologies, edited by Zilouchian A., Jamshidi M., CRC, 2001.
Honey G.: Electronic Access Control, Newnes, 2000.
Konicek J., Little K.: Security, ID Systems and Locks: The Book on Electronic Access Control, Butterworth-Heinemann, 1997.
Phillips B.: The Complete Book of Electronic Security, McGraw-Hill Professional, 2001.
Barnard R.: Intrusion Detection Systems, 2nd ed., Butterworth-Heinemann, 2007.
Cumming N.: Security: A Guide to Security System Design and Equipment Selection and Installation, 2nd ed., Butterworth-Heinemann, 1994.
de Silva C.W.: Sensors and Actuators: Control System Instrumentation, CRC, 2007.

Subject: TFBE1704 Programmable Logic Controllers
Classes/week: 2 hour lecture, 2 hour laboratory
ECTS Credit Points: 4
Prerequisites: TFBE1702 Computer Controlled Measurement and Process Control
Lecturer: István Kocsis, dr. univ.; István Bartha

The goal of the course: Students master implementation of industry control by programmable logic controllers (PLCs).

Topics: Tasks of compact and modular controller installation. Presentation of some specific PLCs. The structure, classification, function model of PLCs. Programming languages, current-path project, block language, flow-diagram language. Implementation of current-path project, sequential network and flow-diagram implementation by relay description. PLCs with modular structure. Design aspects, methods and steps. PLCs with high reliability, self-test, debugging and error correction (erase) methods. Aspects of program development. Structure and functions of developing systems. Programming and possibility of program portability. PLCs buses and sensor buses.

Topics of laboratory: Practical presentation of some programming device structure, and hardware installation problems. Programming with ladder-diagram. Function block programming. Presentation of input attached sensors and output attached actuators problems. Entire control system development. Presentation of GSM communication possibilities. Programming and development of MODBUS communication systems.

Compulsory/Recommended Readings:

Bolton W.: Programmable Logic Controllers, 5th ed., USA: Elsevier Newnes, 2006.
Collins D., and Lane E.: Programmable Controllers A Practical Guide, McGraw-Hill, 1995.
Crispin A.J.: Programmable Logic Controllers and their Engineering Applications, McGraw-Hill, 1997.
Mossis S.B.: Programmable Logic Controllers**,** Prentice Hall, 2000.
Olsson G., and Piani G.: Systems for Automation and Control, Prentice Hall, 1992.
Parr E.A.: Programmable Controllers An Engineer's Guide, Part of Reed International Books, 1993.
Webb J.: Programmable Logic Controllers Principles and Applications, Maxwell Macmillan, 1992.

Subject: TFBE1705 Power Electronics
Classes/week: 2 hour lecture
ECTS Credit Points: 3
Prerequisites: TFBE1701 Electrical Machines and Drives
Lecturer: Kárpáti Attila, PhD; Lajos Daróczi, PhD

The goal of the course: introduction to the components and circuit solutions of power electronics.

Topics: semiconductor components and circuit solutions in power electronic equipments. Line-commutated diode-bridge rectifiers. Phase controlled thyristor converters. AC/DC,AC/AC, and DC/DC converters: buck, boost and buck-boost converters. Control modes: pulse width modulation (PWM) and pulse frequency modulation (PFM).

Compulsory/Recommended Readings:

Erickson R.W., Maksimovich D. Fundamentals of Power Electronics, 2nd ed., USA: Springer Science, 2001.
Bose B: Modern Power Electronics and AC drives, Prentice Hall, 2002.
Motran: Power Electronics + CD, Wiley, 2003.
Sueher K.H.: Power Electronics Design: A Practitioner's Guide, Elsevier, 2005.
Williams B.W.: Power Electronics, ELBS,1992.

Subject: TFBE1706 Sensors and Actuators
Classes/week: 2 hour lecture, 1 hour laboratory
ECTS Credit Points: 3
Prerequisites: TFBE1210 Digital Electronics 2
Lecturer: Imre Szalóki, PhD; István Bartha

The goal of the course: To study systematically the sensor based measuring technologies and related measuring methods. The course provides the metrological properties of the measuring systems using sensors, the evaluation methods of measured data sets and practical experience in application of sensors.

Topics: Definitions of sensors and actuators, their typical measuring properties, noise, nonlinear characteristic, response function, reproducibility, drift, etc. Overview of the basic physical effects for understanding the working principle of sensors. Overview of main group of sensors: sensing geometrical position and direction, temperature, mechanical deformation, force, pressure, acceleration, velocity, magnetic field, electric conductivity, light, ionization radiation. Chemical sensors for detection of gases and ions. The basis knowledge of biosensors. Basic elements of manufacturing procedures of sensors. Applications of sensors: sensors in automotive electronics, sensors in controlling, biomedical sensors, use of sensors in industry and safety-applications. Remote sensing. Evaluation of electric signal of sensors and its application in computerized process control. Actuators: actuators based on piezoelectric effect, servo motors, stepping motors, micro motors and silicon based micro actuators and valves. Basic elements of photometry and human sight. Active and passive display. The basic phenomena, technical structure and main technical properties of different displays: cathode ray tubes, light emitted diode, liquid crystal display, liquid crystal thin films transistor display, organic light emitted diodes, surface conduction electron-emitter display. Fluorescent- and electroluminescent-type displays.

Topics of laboratory: Measuring of temperature by sensors. Application of Hall effects for sensing of magnetic field. Electromagnetic sensors: GM tube, solar cell, pyroelectric effect. Use of piezoelectric effect as mechanical sensor. Acoustic sensor.

Compulsory/Recommended Readings:

Middelhoek S.: Silicon sensors, Academic Press, 1989.
Göpel W.: Sensors, VCH,1993.
Prudenziati M.: Thick Film Sensors, Elsevier, 1994.

Subject: TFBE1501 Energy Sources
Classes/week: 2 hour lecture
ECTS Credit points: 2
Prerequisite: TFBE1102 Physics 2
Lecturer: Péter Raics, PhD

Aim of the course: It gives an overall description on the features and utilization of the main energy sources: fossil, nuclear, renewable, alternatives, bio, wastes. Strategies for further development. Effects to the environment. Economical strategy.

Topic: Fundamentals from physics. Technologies of the energy production and consumption. Modes of exploitation. Fuel cycles. Efficiency, energy production density, load factors. Thermal power generating techniques. Fossile energy resources. New technologies at coal fuelled plants. Characterization of oil and gas fuelled power plants. Locations and forms of the environment pollution. Benefits and drawbacks of different methods. Possibilities of the nuclear power generation and their realizability. Introductory reactor physics and techniques. Conditions for the safety of nuclear energy production. Fuel cycle. Reactor operation. Reprocessing of burnt fuel and waste handling. Reactor accidents, their reasons. Analysis of the effects of the accidents. International comparison. Thermonuclear fusion. Hybrid nuclear systems. New methods for nuclear power generation. Main characteristics of the renewable sources. Direct and indirect application of sun power. Geothermic resources. Bioenergy. Exploitation of wastes. Recent and future possibilities of alternative solutions. Prospectives. Economical security and independence related to energy polices. Public expectations and realities. Expected tendencies and possibilities. Risks, costs, responsibility. Health protection and care. Effects on the environment, protection of nature. Managing of the environment. Short and long term strategies. Self restriction, sustainable development.

Compulsory/Recommended Readings:

Wang X., McDonald J.R.: Modern Power System Planning, London: McGraw-Hill, 1994.
Smith C.B.: Energy management principles, Pergamon, 1981.
Miller R.H., Malinowsky J.H.: Power System Operation, 3rd ed., New York: McGraw-Hill, 1994.

Subject: TFBE1502 Magnetic materials
Classes/week: 2 hour lecture
ECTS Credit Points: 2
Prerequisites: TFBE1102 Physics 2, TFBE1103 Materials Science for Electrical Engineering
Lecturer: Dezső Beke, Prof.

Aim: Introduction to properties of technical magnetic materials. Provide knowledge on the applications of magnetic materials from the transformer sheets across the relays, filters to the nanomagnetic devices (data recording materials and spin-valve systems**).**

Topics: Basic magnetic properties. Domain magnetism. Magnetic hysteresis. Soft magnetic materials. Sensors, relays. Magnetic filters. Hard magnetic materials. Magnetic data recording. Nanomagnetic materials and composites. Spin valves. Barkhausen noise and its technical applications.

Compulsory/Recommended Readings:

Sidorenko S.I., Beke D.L., Kikineshi A.A.: Materials Science of Nanostructures (Ed. M.K. Pynina), Kyiv: Naukova Dumka, 2002.
Beke, D.L., Szabó S., Kis-Varga M.: chapter "Intrinsic and domain magnetism pf magnetic materials" in „Advances in Condensed Matter and Materials Research" Vol. 5. p. 77-112 (Ed. F. Gerard, Nova Science Publications, Inc. New York).
Spaldin N.A.: Magnetic Materials: Fundamentals and Device Applications, Cambridge University Press, 2003.
O'Handley R.C.: Modern Magnetic Materials: Principles and Applications, Wiley-Interscience, 1999.
Jiles D.C.: Introduction to Magnetism and Magnetic Materials, 2nd ed., CRC, 1998.
Cullity B.D., Graham C.D.: Introduction to Magnetic Materials, 2nd ed., Wiley-IEEE Press, 2007.

Advanced Magnetic Nanostructures, edited by Sellmyer D., Skomski R., Springer Science, Vol.XIV, 2006.

Subject: TFBE1503 Application of Microcontrollers
Classes/week: 1 hour lecture, 2 hour seminar
ECTS Credit Points: 2
Prerequisites: TFBE1202 Programming 2, TFBE1210 Digital Electronics 2
Lecturer: Gyula Zilizi, PhD

The goal of the course is student preparation to the proper choice and practical usage of microcontrollers for solving of different tasks.

Topics: MCS48 and MCS51 microcontroller family architecture and instruction set. RISC architecture microcontrollers. Parameters and instruction set of MICROCHIP manufactured microcontrollers. Software and hardware parameters of PIC16F84 microcontroller. Computer development environment (compilers, simulators, emulators). Comparison of some 8, 16 and 32 bit microcontrollers (ATMEL, Cygnal, Cypress, Texas, Philips, Hitachi, Dallas). Microcontrollers in network applications.

Compulsory/Recommended Readings:

Predko M.: 123 PIC Microcontroller Experiments for the Evil Genius, 1st ed., USA: McGraw-Hill, 2005.
Susnea I., Mitescu M.: Microcontrollers in Practice (Springer Series in Advanced Microelectronics), Springer Berlin, 2005.
Predko M.: Handbook of microcontrollers (TAB Electronics Library), USA: McGraw-Hill, 1998.

Subject: TFBE1504 Interfaces
Classes/week: 1 hour lecture, 2 hour seminar
ECTS Credit Points: 2
Prerequisites: TFBE1210 Digital Electronics 2
Lecturer: Lajos Harasztosi

The goal of the course: Basics of computer and peripheral interface protocols and system engineering techniques.

Topics: Data transfer techniques between peripheral and computing units (PC, micro controller, micro processor): serial and parallel protocol, hardware and software considerations with practical examples.(Centronics, GPIB, PXI, SCXI, PCI, RS232, RS422, RS485, IrDa, USB, I^2C, SPI, CAN, FireWire, FieldPoint).

Compulsory/Recommended Readings:

Axelson I.: Parallel port complete, Lake View Research (ISBN 0-9650819-1-5).
Axelson Axelson I.: Serial port complete, Lake View Research (ISBN 0-9650819-2-3).
Hyde J.: USB design by example, John Wiley & Sons, Inc. (ISBN 0-471-37048-7).

Subject: TFBE1506 Nuclear Electronics
Classes/week: 2 hour lecture, 1 hour seminar
ECTS Credit Points: 3
Prerequisites: TFBE1208 Electronics 2
Lecturer: László Oláh, PhD; Gyula Zilizi, PhD

Aim of the course: The main objective of the course is to study the operation and the applications of electronic circuits in nuclear measuring devices.

Topics: Characterization of pulses of particle detectors. Electronics for pulse processing and shaping: linear and logic pulses, cables, preamplifiers, main amplifiers, pulse shaping networks: CR-RC shaping, Gaussian shaping, double differentiation shaping, delay line shaping, pole-zero cancellation, baseline restoration, pile-up rejection. Pulse counting systems: integral discriminator, differential discriminator(SCA), scalers, timers, ratemeters, deadtime. Pulse height analysis systems. Pulse timing: time pick-off methods, coincidence units. Pulse shape discrimination. Time-of-flight technique. Instrument standards. Computer controlled systems: CAMAC, VXI, PC-cards.

Compulsory/Recommended Readings:

Knoll G.N.: Radiation detection and measurement, New York: John Wiley & Sons, 1989.
CANBERRA: Laboratory Manual for Nuclear Science, Meriden USA, 1988.
Horowitz P.: The art of electronics, Cambridge University Press, 1989.

Subject: TFBE1507 Applied Electronics
Classes/week: 1 hour lecture, 2 hour laboratory
ECTS Credit Points: 2
Prerequisites: TFBE1208 Electronics 2
Lecturer: Gyula Zilizi, PhD; László Oláh, PhD

Topics: Electroacoustics devices and systems. Microphone and pick-up types. Speakers (subwoofers, woofers, tweeters), active and passive crossover circuits, sound boxes. Bass and treble controls, equalizer circuits. Preamplifiers, power amplifiers. The electronics of tape recorders. Bias; DC and RF erase. The Dolby B and C system. Video technology basics. B&W and colour composite video signal; the PAL system. Analogue and digital video transmission, broadcast and record devices. VHS and DVD videorecorders, Hi-Fi sound reproduction. CD and DVD standards. Error correction, CIRC and EFM encoding. Data reduction techniques, MPEG and other compression methods. Sound cards, FM and wavetable synthesis. The MIDI standard.

Compulsory/Recommended Readings:

Relevant links on the following web page: www.epanorama.net

Subject: TFBE1508 Digital Image Engineering
Classes/week: 2 hour lecture, 1 hour seminar
ECTS Credit Points: 3
Prerequisites: TFBE1202 Programming 2
Lecturer: Csaba Cserháti, PhD; István Szabó, PhD

The goal of the course: The course is going to provide practical techniques and mathematical principles of image manipulation, processing and machine vision. It will present how to get utmost information of the images provided by cameras or other equipments used in technological applications.

Topics: Human and computer vision. Introduction to digital images: sampling, quantization, color images. Introduction to the image processing. Geometrical transformations. Image enhancement: pixel brightness, local preprocessing, image restoration. Linear discrete image transforms (Fourier transform and filtering). Segmentation: thresholding, edge-based segmentation, region growing segmentation, matching. Machine vision.

Compulsory/Recommended Readings:

Sonka M., Hlavac V., Boyle R.: Image Processing: Analysis, and Machine Vision, 2nd ed., Brooks and Cole Publishing, 1998.

The following documents are available from the NI home page, or from the Institute of Physics's e-Learning site:

IMAQ Vision Concepts Manual.
IMAQ Vision fo Labview Users Manual.
NI Vision Builder for Automatic Inspection Users Manual.

Subject: TFBE1509 Property Protection and Alarm Systems
Classes/week: 2 hour lecture, 1 hour seminar
ECTS Credit Points: 3
Prerequisites: TFBE1209 Digital Electronics 1
Lecturer: Károly Szandtner, dr. univ., Sándor Misák, PhD

The goal of the course: mastering of basic knowledge for solution of technical problems of property protection.

Topics: Tasks of property protection. Possibilities and aspects of applicability of complex property protection. Mechanical property protection, solutions and devices of indoors property protection. Electronic property protection systems, sensors. Signal transmitting systems. Alarm implementation. Remote-control systems. Repair, maintenance

and control of alarm systems.

Compulsory/Recommended Readings:

Kennedy T., Traister J.E., Low Voltage Wiring: Security / Fire Alarm Systems, McGraw-Hill Professional, 2001.
Honey G.: Electronic Security Systems Pocket Book, Newnes, 1999.
Brown A.L.: Domestic Security Systems: Build or Improve Your Own Intruder Alarm System, Newnes, 1997.
Honey G.: Electronic Protection and Security Systems, 2nd ed., Newnes, 1998.
Konicek J., Little K.: Security, ID Systems and Locks: The Book on Electronic Access Control, Butterworth-Heinemann, 1997.
Phillips B.: The Complete Book of Electronic Security, McGraw-Hill Professional, 2001.

Subject: TFBE1510 Robotics
Classes/week: 2 hour lecture
ECTS Credit Points: 2
Prerequisites: TFBE1213 Automation 2
Lecturer: István Szabó, PhD

The goal of the course: Fundamentals of robot construction and control.

Topics: The history of robotics. Kinematic and dynamic models for robot control, methods for motion path design. Structural element: actuators and sensors. Motor control. Fundamentals of machine vision. Navigation systems. Robot control architectures. Real time and distributed signal processing systems. Autonomous systems, agent systems, artificial intelligence. Robot simulation. Application examples and problems: robolab, industrial robotic manipulators, autonomic vehicles, robotic soccer, humanoid roots.

Compulsory/Recommended Readings:

Schilling R. J.: Fundamentals of Robotics: Analysis and Control, Prentice-Hall International, 1990.