COURSES OFFERED FOR INCOMING STUDENTS (EU Erasmus, UNH, FIT, Simon Fraser, Manitoba State, etc.)

SPRING SEMESTER 2010

Budapest University of Technology and Economics
Faculty of Electrical Engineering and Informatics (www.vik.bme.hu)

Notations: (lectures/practical lectures/laboratory/**p**= term mark, **e** = exam - ECTS credit amount)

BSc Degree programs in Electrical Engineering

BMEVIAUA116 - Basics of Programming 2 (2/0/2/p – 4 credits)
This course, as a basic BSc. course, based on the previous term, continues the exposition of the methods and tools of the computational problems. The main goal of the course is the introduction of object-oriented programming. Based on the C programming language skills, the object-oriented techniques are introduced with the help of the C++ programming language. The curriculum of the computer laboratories continuously follows the lectures.

BMEVIIIA108 - Digital Design 2 (2/2/0/e – 5 credits)
Architecture of digital systems. Control and data path. Classification of bus systems. Basic principles and evolution of the architectures of digital computers. Microprocessors and microcomputers. Functional units and bus systems of microcomputers. Interfacing of RAM and ROM units to bus systems. Basic principles of assembly programming. The instruction set of a simple microprocessor. Memory organization (FIFO, LIFO, stack). Interrupt systems in microcomputers, priority structures, programmable interrupt-handling units. Programmable input-output system. Parallel and serial data transmission units. Direct memory access (DMA) and its controller interfacing. Microcontroller architectures. Design example with microcontroller. Digital signal processors (DSP) and its evolution, basic principles for application. Classification of FPGA developing systems and their main services.

BMEVIHVA109 - Signals and Systems 1 (4/2/0/p – 6 credits)
Signals, systems and networks. Two-poles, Kirchhoff's laws. Linear resistive networks. The complete and the reduced sets of network equations. Regularity of the network. Superposition principle. Series and parallel connection of resistors, voltage splitting, current splitting. Delta-Wye transformation. Equivalent generators. Power matching. Node analysis. Loop analysis. Coupled two-poles. Ideal transformer, controlled sources, ideal amplifier, gyrator. Linear two-ports; reciprocity, symmetry passivity. Equivalents of reciprocal and non-reciprocal two-ports. Input and transfer quantities of loaded two-ports. Capacitor, inductor, coupling. Network equations. Regularity. Initial values. State variable description. Solution of the state variable description: free and excited components. First and higher order networks. Asymptotic stability. Dirac impulse. Impulse response and its application. Input-output stability (BIBO). Sinusoidal signal, phasor representation. Impedance, transfer coefficient. Calculation methods. Powers, power matching. Three-phase networks, symmetric and general systems. The transfer characteristic and its graphical representation by the Nyquist- and Bode-plot. Fourier-series form of forced response to periodic excitation. Mean values and other characteristic quantities. Spectral representation of signals, Fourier transforms. Bandwidth of the signal and of the system. Distortionless signal transfer. Band-limited signals, sampling.

BMEVIHVA204 - Electromagnetic Fields (3/1/0/e – 5 credits)
Transmission lines, sinusoidal steady-state, transient phenomena. Electric charge and current. Electric field strength, magnetic flux density. Electric and magnetic potential. Electric flux density, magnetic field strength. Linear and non-linear materials. Energy and power density. Pointing vector. Maxwell's equations. Boundary and continuity conditions. Static electric field. Laplace's equation, solution methods. Stationary magnetic field, Biot-Savart and Neumann laws. Electromagnetic waves, retarded potentials. Hertzian dipole., far field. Plane waves in insulators and conductors. Wave guides, dielectric guide. Numerical methods: variational principles, Ritz and Galerkin procedures, finite difference, finite element and global formulation. Boundary element formulation.

BMEVIHIA205 - Electronics 1 (3/2/0/e – 6 credits)
Basic analog transistor circuits. Basic single transistor amplifier stages. Small signal equivalent circuits of the basic single-stage amplifiers. Common base (gate), common emitter (source), common collector (drain) amplifier stages. Degenerate common emitter (source) stages; analysis and features. Frequency response of the amplifiers. High frequency small signal models, the Miller-effect. Low frequency analysis of the transistor circuits. Biasing of active devices. Current mirror. Maximum output signal analysis of the transistor circuits. Power amplifiers; A, AB, B, C, AD and BD power stages. Two-transistor basic amplifiers. Differential amplifier, cascod stage. Differential amplifier: large signal analysis and transfer characteristics; incremental analysis and half-circuit analysis techniques. Nonlinear distortion of the transistor stages. Harmonic and cross modulation distortion. Ideal operational amplifier, basic circuits. Structure of the operational amplifiers. The effect of the feedback to the small signal parameters. Frequency compensation of the feedback amplifiers. Comparator circuits. Sample and hold circuits. D/A and A/D converters. Schmitt trigger, mono-stable multi-vibrator. Oscillators, square-wave relaxation oscillator, astable multivibrator, sinusoid RC and LC oscillators, crystal oscillators. Basic elements of the digital electronic circuits. Parameters of the digital inverter: logic levels, delay time, etc. The transfer characteristics of the digital inverter, threshold level. The CMOS logic circuits. Basic CMOS inverter, W/L ratio, transfer characteristics. Dynamic behavior of the CMOS circuits. The structure of the CMOC gates.

BMEVIMIA206 - Measurement Technology (3/2/0/p – 5 credits)
The aim of the subject is to give insight into metrology, measurement theory and technology, instrumentation. Besides its theoretical aspects it helps the preparation for laboratory practices. Model building and problem solving skills of the students are developed. The subject focuses on the measurement of electrical quantities, but emphasizes the analogies with non-electrical problems. The main topics are the followings.
1. Basics of measurement. Measurement and modeling, sensors, bridge circuits.
2. Basics of measurement theory. Basic methods and structures. Calculation of measurement error, uncertainty. Statistical methods. Uncertainty calculation based on GUM (Guide to the Expression of Uncertainty in Measurement)
3. Measurement of signals and their main parameters. Measurement in the time and frequency domain.
4. Signal connection and conditioning. Noise sensitivity, impedance-matching, shielding. Rectifiers. Analog-to-digital and digital-to-analog converters.
5. Measurement of frequency and time. Digital counter-based instruments and their extensions.
6. Measurement of basic electric quantities. Measurement of voltage, current, energy, power, impedance. Impedance and connection modeling. Low- and high-precision methods. Bridge circuits.
7. Signal sources. Sine and function generators. Frequency synthesizers, phase-locked loops.
8. Signal analysis tools. Analog and digital oscilloscopes, spectrum analyzers. Fourier analyzers.
9. Calibration of instruments. Calibration processes. Traceability of measurement results.

10. Testing and diagnostics. Automatic instruments for testing and diagnostics. Self-calibrating and self-correcting instruments.

BMEVIVEA207 - Power System Engineering (3/1/1/e – 5 credits)
Survey of the electric power generation, transmission and distribution. Evolution of prime movers and fuel in traditional societies. Electrical energy and the quality of life. Build-up and the principles of the symmetric operation of three phase electric power systems. Summary of the characteristics of the active- and reactive-power. Modeling of the network elements (generator, transformer, transmission line, load). Analyses of the symmetrical stationary operation and three-phase short circuit. Managing of multiple voltage level networks, use of the per unit system. Basic principle and analyses of the asymmetrical conditions. Bases of the symmetrical component method. Role and managing of earth return. Managing of network unbalance and harmonic problems. Ways of neutral grounding and their effects on the earth fault currents and over-voltages. Applied neutral grounding practices. Analyses of stationary transmission. Voltage analyses of radial network, power relations in a meshed network. Limits of energy transmission, voltage- and static-stability. Bases of the control of power and frequency (P-f) and reactive-power and voltage (Q-U). Methods of flexible a.c. transmission systems (FACTS). Power quality requirements, voltage quality and quality of the supply. Electric and magnetic fields of power installations and equipments and the involved biological and EMC effects. Numerical examples and case studies.

BMEVIVEA335 - Electric energy transmission (3/1/0/e – 4 credits)
This course allows students to acquire a system oriented approach necessary to design and operate electric power transmission networks. Starting with the explanation of the theoretical background of the related physical phenomena, the course provides application oriented skills including the operation and calculation of such networks. **Contents:** Architecture of the electric power system, network transformations, the process of energy transmission and distribution. Network elements for the transmission and distribution tasks, interpretation of the calculation parameters of the networks elements, their determination and mapping. Calculation methods in multiple voltage networks. Method of symmetric components. Determination of transformer and transmission line parameters. The four conductor model of a transmission line. Steady state operation of transmission lines and transformers. Power transmission in medium and high voltage lines. Power and voltage relations in steady state, network losses. Calculation methods and their applications in high voltage loops. Voltage and current relations for transformer and line short circuits. Fundamental harmonic analysis of short circuits and power off switching. Principle and methods of star-grounded solutions, the related fundamental harmonic analysis for failure states.

BMEVIVEA334 - Electric machines and applications (3/1/0/e – 4 credits)
The course introduces the basic concepts of electromechanical electric energy transformations and describes the construction and operation of the most important types of electric machines including their equivalent circuits and characteristic curves. The course also studies the steady state operating regimes of tri-phased machines for symmetric and asymmetric feed and presents the fundamentals of vector methods and servo systems. **Contents:** Architecture of transformers and their transient and steady state regimes. Windings of rotating machines, calculation of forces and moments. Equivalent scheme and torque of asynchronous machines, their start and speed switching methods. Equivalent circuit and torque of synchronous machines, stability. Windings of direct current machines, the role of the auxiliary pole and the compensating winding. External, parallel and mixed excitation machines and generators. Application of modern calculation techniques: introduction to the finite element methods, application of the latest field calculation software, the solution of the planar problem. Application of electric machines: household appliances, entertainment electronics, automotive industry, magnetic levitation, superconductor generators and motors, servo motors.

Kinetics of electric drives. Design of electric drives (protection modes, operating regimes, heat-removal, model selection for different regimes). Applications of electric drive systems (public transportation vehicles, railroad systems, wind-power plants).

BMEVIBEA336 - Electric switching devices (3/1/0/e – 4 credits)
The course presents the interactions between the electric networks and the low and high voltage switching devices due to their operations. The course also describes the architecture of switching devices and fuses and explains their functioning principles. **Contents:** Electric switching devices in low and high voltage networks. Calculation models and methods of switching devices and networks. Power-on of direct and alternating current. Short circuit close to the generator or far from the generator. Capacitive load and the power-on of a transformer without load. Thermal stress, modeling of heating phenomena due to normal operation, overload, or short circuit current. Mechanical stress. Calculation methods of electro dynamical forces applied to the conductors. Phenomena in stationary electric arc. The electric arc as circuit element. Characteristics of stationary and dynamic arcs. Characteristics of the quasi stationary arc and its elimination. Properties of the electric arcs in vacuum. Ideal power-off of direct and alternating current. Ideal power-off of high voltage alternating current. Break of an alternating current arc at high voltage. Dangers of reigniting when load currents are cut. Break of an alternating current arc at low voltage. The current limiting effect of the arc. Architecture and operation principles of high voltage SF_6 gas and vacuum breaker switches. Architecture and operation principles of fuses, low voltage switches and contactors. Architecture and operation principles of high, medium and low voltage disjunctors and disjunctor-like devices.

BSc Degree programs in Software Engineering

BMEVISZA110 - Introduction to the Theory of Computing 2 (2/2/0/e – 4 credits)
Algorithms in graph theory (minimum cost tree, shortest path, maximum matching, flow problems, topological sorting, PERT method). Higher connectivity numbers of graphs. Graph coloring problems (vertex, edge and map coloring). Euler- and Hamiltonian circuits. Basic concepts in number theory (divisibility, primes, congruencies, Euler-Fermat theorem), algorithms in number theory (prime tests, public key cryptography). Basic concepts of abstract algebra (operations, structures), semi-groups. Groups, their relations to transformations, important special groups, factor group. Rings and fields.

BMEVISZA213 - Theory of Algorithms (2/2/0/e – 5 credits)
Algorithms. Sequential and binary search. Search with some basic data structures, like search tree, AVL tree, B-tree, hash table. Sorting by insertion, merge sort, heap sort, quicksort, bin sort, radix sort and the analysis of these methods. The complexity of sorting. Basic graph theoretical algorithms: BFS, DFS and their applications to determine (strongly) connected components. Algorithms for acyclic graphs. Finding maximal matching in bipartite graphs. Determining shortest paths by methods of Bellman-Ford, Dijkstra, and Ford. Minimal spanning tree algorithms and the union-find data structure. General algorithmic methods: branch and bound, divide and conquer, dynamic programming. Efficient approximation algorithms. Algorithmically hard problems, the notion of NP and NP-completeness.

BMEVIHVA214 - Signals and Systems (3/1/0/p – 5 credits)
Definition of signals, systems and networks. Classification. Causality, linearity, invariance. Basic operations on discrete time (DT) and continuous time (CT) signals. Time domain description of DT and CT systems. Impulse response, convolution, input-output (BIBO) stability. State space description, response calculation, asymptotic stability. Signal flow networks (SFN). Frequency domain description. Sinusoidal signal, phasor representation. Canonical SFN representations. Nyquist and Bode plots. Periodic signals, Fourier series. Fourier transform, distortionless signal transmission. Complex frequency domain description. Transfer function, pole-zero pattern. Laplace transformation. Special (all-pass, minimum-phase FIR) systems. DT simulators of CT systems.

BMEVIMIA111 - Digital Design 2 (2/2/0/e – 5 credits)
MSI functions: decoders, multiplexers, comparators, three-state buffers, ALUs, registers, counters, shift registers. Programmable logic devices: ROMs, RAMs, PLAs and PLDs. Data and control structures. Logic design methods for digital control units: phase register, micro programming. Introduction to microprocessors. Architecture and operation of microprocessor: CPU, memory, peripheral equipment, bus systems. I/O organization, interface circuits, and handlers. Introduction to RTL-level hardware design languages.

BMEVIHIA215 - Computer Networks (3/1/0/e – 4 credits)
Fundamentals in Computer Networks. Classification. History. Standardization. Convergence. Communication of Remote Processes. Modeling and reference Models: ISO-OSI and TCP/IP. Physical Level Data Transmission. Problems of signal generation, signal transmission and data recovery. Analog transmission: modems, standard serial interfaces. Digital transmission: line encoding, codec. Multiplexing techniques: FDM and TDM. Asynchronous and synchronous transmission. Private and public data networks. ISDN, ADSL, cable TV. Data Link Level Data Transmission. Type of services. Tasks to be solved: framing, error control, flow control, link management. Data link protocols. Data Link Level Data Transmission in LANs. Features of LANs. Special characteristics of the LAN Reference Model. MAC protocols. LLC protocols. Wireless

LAN protocols. Network Level Data Transmission. Type of services in packet switched networks: datagram and virtual circuit. Routing. Congestion control. Interconnection of networks. Gateway, router, bridge, switch, repeater. Internet protocols. Transport Level Data Transmission. Type of services. Elements of protocols. Addressing. Transport connection management. Flow control. Multiplexing. TCP and UDP. Higher Level Services. Session and presentation level services. Application Level Services and Protocols. Application level of TCP/IP Reference Model. DNS. E-mail. Web. Network Management. Reasons of network management. Tasks to be solved. Hardware and software elements. SNMP.

BMEVIIIA114 - Basics of Programming 2 (2/2/0/p – 4 credits)
The objectives of this course are to introduce students to the concept of object oriented programming and to provide them the hands-on experience of programming in C++. This semester focuses on leading the students to a deeper understanding of C language, and focus is also put on the steps of solving very complex programming tasks using an object-oriented approach. The latter is achieved via learning the C++ language, assuming a reliable knowledge of C. The practice classes follow the topics of the lectures and discuss further details of the object-oriented concept and the language elements. First the students learn how the C++ language derives from C. Inline macros, prototypes, default arguments and function overloading are explained. Dynamic memory allocation process of C++, reference type, visibility and scope of data are discussed. Next the object-oriented concept is introduced via the C++ language. The principles and concepts behind the object oriented programming paradigm are shown with the corresponding C++ syntax. Topics include classes, encapsulation, protection; member functions, constructor/destructor, friend mechanism; operator overloading; inheritance, virtual functions; generic classes. Last the students are introduced to essential operating system functions and to development and documenting tools.

BMEVIAUA218 - Software Techniques (3/1/0/e – 4 credits)
The class members will be exposed to the techniques of manufacturing object oriented software systems, as well as the most important methods of event-driven programming. Moreover, the students acquire familiarity with the structures and fundamental implementation techniques of graphical user interface and the rapid application development approaches. Presenting the Windows/Linux programming facilities along with the analysis of the roles and the significance of class libraries and their comparison are also among the focused topics. Besides the development-oriented methods, the most important principles of the source code management systems (SourceSafe, ClearCase, CVS, etc.) are also focused because of the important role they play in software life cycles. We also stress the client side development, including but not limited to thick and web-based clients. The conveyed knowledge is illustrated by case studies. In summary, ‘Software Methods’ provide the fundamental knowledge to develop software for the most current and popular platforms (e.g. Windows, Linux) with up-to-date tools and technologies.

BMEVITMA314 - Management of Information Systems (3/1/0/e – 4 credits)
System-level overview and architectures. Strategic level design, implementation and operation tasks. Life cycle of information systems. Total Cost of Ownership, TCO management. Typical architectures, central, client-server, 3-layer schemas. Quality of Services. Reliability, Availability, Serviceability (RAS). Manageability. Asset management, system management, server management, network management,. inventory management, configuration management, power management, Structure of Management Information (SMI). Management Information Base (MIB). Internet Standard MIB, Private MIB. Common Information Model (CIM). Management Object Format (MOF). Simple Network Management Protocol (SNMP). Windows Management Interface (WMI), Web-Based Enterprise Management (WBEM). Standards. Integrated Network and System Management (INSM). Management Information Format (MIF). Desktop Management Task Force

(DMTF). Desktop Management Interface (DMI)., Management Interface (MI), Advanced Configuration and Power Interface (ACPI), Boot Integrity Service (BIS). Interoperability issues. Operating tasks. System log, event management, fault management. Data storage management. Scalability basics. Maintenance, maintenance strategies. Documentation standards. Software upgrade.

BMEVIMIA219 - Operating Systems (3/1/0/e - credits)
The aim of the course is to introduce the operation and principles of the operating systems, the programming models of the concurrent and distributed systems, and the selection and design criteria of proper systems. The principles and the operation are illustrated through real examples. During the lectures and the labs associated to the course the mutual influence of the computer hardware and software is also emphasized thus the course results in engineering skills and knowledge in the field of operating systems. Lecture: Introduction. History of the operating systems. Today's operating systems. General description: Tasks, interfaces, functions, structures, operation. Processes and threads. Process co-operation, synchronization, and communication. Deadlock. Multiprogramming and multiprocessing systems. Queuing and state transition models. CPU scheduling. Memory management. Virtual memory management. Secondary storage management. File management. Periphery handling. Programming interfaces. Protection and security. User level knowledge. Selection criteria and system design. The UNIX operating systems. Internal structure. Scheduling. Signal handling. Process communication. File management. Distributed systems. Basics. Network communication. Distributed file systems. Distributed operating systems. Distributed coordination. Security and protection. Labs: Illustrative examples, case studies, user level knowledge.