BULLETIN

Budapest University of Technology and Economics

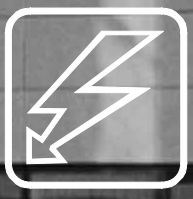
2006–2007

An ECTS Guide

Engineering Programs in English

http://www.tanok.bme.hu

Faculty of
Electrical Engineering and Informatics



The Faculty of Electrical Engineering founded in 1949 has been renowned for excellence in research and education throughout the years of changes in the scope of engineering. Over this period, the faculty has earned a wide-spread international reputation for its high academic standards and scientific achievements. Spearheading the movement to establish a modern education system, it has offered a comprehensive English curriculum since 1992. Nearly the same time, the name of the faculty was changed to Faculty of Electrical Engineering and Informatics in order to give recognition to the growing importance of computer science. The English education package includes a 3.5-year B.Sc., a 2-year M.Sc. and a 3-year Ph.D. programme in the fields of electrical and software engineering.

This Bulletin describes the curricula and the subjects being available for the 2006/2007 academic year, regarding the BSc, MSc and PhD programmes, respectively.

The undergraduate **B.Sc. programme** aims at providing a comprehensive knowledge with sound theoretical foundations in two areas: *(1) Electrical Engineering* including more specific studies in electronics, computer engineering and power engineering; and *(2) Software Engineering* dedicated to the major domains of computer science. The major specializations in Electrical Engineering are computer networks, control and robotics and power engineering. Studies in Software Engineering include specialization in infocommunication and software technology. Each specialization contains three courses focusing on the field of interest followed by a laboratory course and a project laboratory. In order to pursue studies in a given specialization the number of students must exceed a certain threshold, otherwise the interested students are kindly directed to another specialization.

The graduate **M.Sc. programme** further advances the knowledge obtained in the undergraduate programmes in the same two fields: *(1) Electrical Engineering*, thrusting in communication, computer, and control engineering; *(2) Software Engineering* dealing with system and software development.

The post-graduate **Ph.D. programme** is available in all domains offered in the MSc program.

Since research and development requires innovative engineering expertise, one of the major concerns of the faculty is to endow students with high level mathematical skills in modeling complex engineering systems. This objective implies the use of system and algorithmic theory in addition to a thorough knowledge in physics. The search for optimal solutions in the highly complex architectures of electrical and software engineering necessitates not only engineering but economical considerations, as well. As a result, the scope of the programme must include design, research and management expertise at the same time.

Several strategies have been designed to help students develop high level skills in mathematics, physics, and computation. Besides theoretical knowledge they need to carry out design and development activities in the field of communication, instrumentation, and power industries to further perfect their practical skills. The curriculum also includes solving tasks in the fields of production and operation.

Scientific groups are formed to encourage the students to do independent but supervised laboratory work. Project laboratory is one of the core parts of the studies which are dedicated to independent problem solving with the armoury of modern work stations and SW packages. The expertise of handling these tools are inevitable in pursuing an engineering career.

In order to strengthen the transfer of knowledge and know-how between the university and industry, the faculty maintains close contact with well known multinational companies in the field of communication and computer industry. As a result, many industrial experts offer their experience and knowledge as part-time lecturers, project supervisors, members of examination committees.

Admission policy

To maintain a high educational standard is the basic interest of both the university and the students. Only a constant guard of quality can ensure that tuition fee is traded for a degree of high reputation bearing a competitive value in the global market. Therefore, the priority of our acceptance policy is sustaining the quality of education by selecting those students whose knowledge and previous qualifications are in match with the expertise required by the courses. This rule holds for all applicants, no matter the country or the educational institutions they came from. Only the implementation of this acceptance policy helps us to preserve the value of the degree, which the students rightly deserve in exchange of their tuition fee and in exchange of their continuous effort committed during the course. In order to implement the principles, our faculty has adopted the following terms of acceptance:

Practical guidelines for acceptance to the MSc programme

1. Applicants with B.Sc. studies having a WGAP (Weighted Grade Average Point) equal or better than 'good' and with a B.Sc. degree issued not earlier than five years prior to the application will receive unconditional acceptance to the M.Sc. course.
2. Applicants with B.Sc. studies having a WGAP equal or better than 'good' and with a B.Sc. degree issued earlier than five years prior to the application will receive conditional acceptance to the M.Sc. course. The term 'conditional acceptance' means that the applicant has been approved for admission as a provisional graduate student in the Pre-M.Sc. degree program in Electrical or Software Engineering. The Pre-M.Sc. degree program is a two-semester course for applicants who have B.Sc. degree, but who needs to brush up or improve his or her knowledge in science and technology. An applicant can then continue his or her studies in one of our four-semester M.Sc. programmes, and can receive regular M.Sc. student status if he or she achieves a WGAP of good or better in this course. Failure to achieve this grade results in revoking the admission.
3. Applicants with a B.Sc. qualification less than 'good' are regretfully rejected to enter the M.Sc. program.

Practical guidelines for acceptance to the PhD programme

1. The primary condition of admission to postgraduate studies is that the applicant must hold a Master of Science (or Engineering) degree in Electrical and Electronic Engineering (or in some closely related fields) or Informatics. Admission to postgraduate studies will be considered if the qualification of previous studies is at least of level "good" or equivalent.

2. Applicants are expected to have a definite scope of research in electrical engineering or computer science, where they would like to advance their knowledge. They are requested to present a proposal, specifying a domain of interest with some research objectives, milestones and deliverables during the postgraduate studies. The suggested topic should have sufficient preliminaries in their university studies.

3. Applicants with experience and initial results in the suggested research topic will have preference. A short summary of preliminary research activities together with relevant reports, published papers ... etc. would be of help in the admission process.

4. Applicants should also submit two recommendations given by renowned academic personnel.

Each admission is valid only for the forthcoming academic year (starting right after the letter of acceptance). In the case of commencing studies later than the semester indicated in the letter of acceptance, or returning to studies after a passive semester, the faculty does not take responsibility for ensuring that the students can follow the same specialization which he studied prior to the passive semester, and reserves the right to direct the student to other specialization depending on the changes in the number applicants for specializations .

Departments

Automation and Applied Informatics, Broadband Infocommunication and Electromagnetic Theory, Computer Science and Information Theory, Control Engineering and Information Technology, Electric Power Engineering, Electron Devices, Electronics Technology, Measurements and Information Systems, Telecommunications, Telecommunications and Mediainformatics

Budapest University of Technology and Economics
Faculty of Electrical Engineering and Informatics
Faculty Office:
Building Z, 2nd Floor, Room No. 201.
Mailing Address: Bertalan Lajos utca 2.
H-1111 Budapest, Hungary
Phone: (+36-1) 463-3898
Fax: (+36-1) 463-2460
E-mail: nagy-margit@tanok.bme.hu

Dean of the Faculty: Prof. Dr. Gábor Péceli
Vice-Dean of the Faculty: Dr. János Levendovszky
Course Directors:
B.Sc. Program: Dr. Károly Veszprémi
M.Sc. Program: Dr. József Harangozó
Ph.D. Program: Dr. József Harangozó
Program Co-ordinator: Ms. Margit Nagy

Curriculum of B.Sc. Subjects in Electrical and Software Engineering

Subject			Working hours / semester								Requisites
Name	Code	Credits	1	2	3	4	5	6	7	8	
English Language I	BMETKGTB101	2	4								
English Language II	BMETKGTB201	2		4							
English Language III	BMETKGTB301	2			4						
English Language IV	BMETKGTB401	2				4					
Obligatory Econ. & Human Science Electives											
Ergonomy	BMEGT52A001	2									
Philosophy	BMEGT41A001	2									
Economical Politics	BMEGT33A001	2									
Information Management	BMEGT46A001	2									
Innovation Management	BMEGT44A001	2									
Communication	BMEGT43A001	2									
Environment Economics	BMEGT42A001	2									
Research Methodology	BMEGT41A002	2									
Vision, Language, Memory	BMEGT47A001	2									
Marketing	BMEGT33A002	2									
Technical English	BMEGT63A051	2									
Technical French	BMEGT62AF51	2									
Technical Dutch	BMEGT61AH51	2									
Technical Hungarian	BMEGT65A051	2									
Technical German	BMEGT61A051	2									
Technical Italian	BMEGT62AO51	2									
Technical Russian	BMEGT64A051	2									
Technical Spanish	BMEGT62AS51	2									
Pedagogy	BMEGT51A001	2									
Money Matters	BMEGT35A001	2									
Psychology	BMEGT52A002	2									
Regional Economy	BMEGT42A002	2									
Accounting	BMEGT35A002	2									
Sociology	BMEGT43A002	2									

Curriculum of B.Sc. Subjects in Electrical Engineering

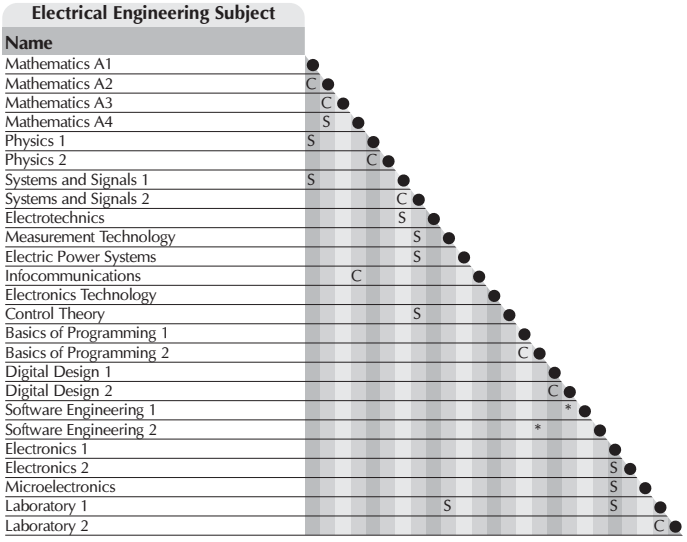
Subject			Working hours / semester								Requisites
Name	Code	Credits	1	2	3	4	5	6	7	8	
Economics and Human Science Studies											
Micro- and Macroeconomics	BMEGT30A001	4		3/1/0/p							
Management and Business Economics	BMEGT20A001	4				4/0/0/p					
Business Law	BMEGT55A001	2					2/0/0/p				
Obligatory Econ. & Human Elective 1		2	2/0/0/p								
Obligatory Econ. & Human Elective 2		2					2/0/0/p				
Obligatory Econ. & Human Elective 3		2						2/0/0/p			
Obligatory Econ. & Human Elective 4		2							2/0/0/p		
Obligatory Econ. & Human Elective 5		2							2/0/0/e		
Elements of Natural Science											
Mathematics A1	BMETE90AX00	6	4/2/0/e								
Mathematics A2	BMETE90AX02	6		4/2/0/e							BMETE90AX00-C
Mathematics A3	BMETE90AX09	4			2/2/0/e						BMETE90AX02-C
Mathematics A4	BMETE90AX08	4			2/2/0/p						BMETE90AX02-S
Physics 1	BMETE11AX01	5		2/2/0/e							BMETE90AX00-S
Physics 2	BMETE11AX02	5			2/2/0/e						BMETE11AX01-C
Foundation of Computer Science	BMEVISZA105	6	4/2/0/e								
Material Science	BMEGEMTAV01	4	3/0/1/e								
Software Engineering 1	BMEVIIIA202	5			3/2/0/e						BMEVIIIA108*
Software Engineering 2	BMEVIAUA203	5				3/2/0/e					BMEVIHIA107*
Free Elective Subjects											
Free Elective 1		4						4/0/0/e			
Free Elective 2		4							4/0/0/e		
Free Elective 3		2							2/0/0/e		
Fundational Technical Studies											
Basics of Programming 1	BMEVIHIA106	5	2/1/1/p								
Basics of Programming 2	BMEVIHIA107	4		2/0/2/p							BMEVIHIA106-C
Digital Design 1	BMEVIIIA104	7	4/2/0/e								
Digital Design 2	BMEVIIIA108	5		2/2/0/e							BMEVIIIA104-C
Systems and Signals 1	BMEVIHVA109	6		4/2/0/e							BMETE90AX00-S
Systems and Signals 2	BMEVIHVA200	6			4/2/0/e						BMEVIHVA109-C
Electrotechnics	BMEVIVEA201	6			4/0/1/p						BMEVIHVA109-S
Electromagnetic Fields	BMEVIHVA204	5				3/1/0/e					
Electronics 1	BMEVIHIA205	6				3/2/0/e					
Electronics 2	BMEVIHIA300	6					3/2/0/e				BMEVIHIA205-S
Microelectronics	BMEVIEEA306	5						3/2/0/e			BMEVIHIA205-S
Measurement Techniques	BMEVIMIA206	5				3/2/0/p					BMEVIHVA200-S
Electric Power Systems	BMEVIVEA207	5				3/1/1/e					BMEVIHVA200-S
Infocommunications	BMEVITMA301	5					3/2/0/e				BMETE90AX08-C
Electronics Technology	BMEVIETA302	5					3/1/1/e				
Control Theory	BMEVIAUA303	5					3/2/0/e				BMEVIHVA200-S
Specialization Studies											
Specialization Theoretical Subject 1		4						3/1/0/e			
Specialization Theoretical Subject 2		4						3/1/0/e			
Laboratory 1	BMEVIMIA304	5					0/0/4/p				BMEVIMIA206-S BMEVIHIA205-S
Laboratory 2	BMEVIMIA305	5						0/0/4/p			BMEVIMIA304-C
Laboratory for Specialization		2						0/0/2/p			
Project Laboratory		4						0/0/3/p			
Obligatory Spec. Elective		5							4/0/0/e		
Thesis		15							0/14/0/s		

Curriculum of B.Sc. Subjects in Software Engineering

Subject			Working hours / semester								Requisites
Name	**Code**	**Credits**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
Economics and Human Science Studies											
Micro- and Macroeconomics	BMEGT30A001	4	4/0/0/p								
Management and Business Economics	BMEGT20A001	4		3/1/0/p							
Business Law	BMEGT55A001	2			2/0/0/p						
Obligatory Econ. & Human Elective 1		2	2/0/0/p								
Obligatory Econ. & Human Elective 2		2			2/0/0/p						
Obligatory Econ. & Human Elective 3		2				2/0/0/p					
Obligatory Econ. & Human Elective 4		2				2/0/0/p					
Obligatory Econ. & Human Elective 5		2						2/0/0/p			
Elements of Natural Science											
Calculus 1	BMETE90AX04	7	4/2/0/e								
Calculus 2	BMETE90AX05	7		4/2/0/e							BMETE90AX04-C
Probability Calculus	BMEVISZA208	4			2/2/0/e						BMETE90AX05*
Introduction to Computer Science 1	BMEVISZA103	5	2/2/0/e								
Introduction to Computer Science 2	BMEVISZA110	4		2/2/0/e							BMEVISZA103-S
Coding Techniques	BMEVIHIA209	5			3/1/0/p						BMEVISZA110-C
Theory of Algorithms	BMEVISZA213	5				3/1/0/e					BMEVISZA110-S
Physics 1	BMETE11AX03	4		2/2/0/e							
Physics 2	BMETE11AX04	4			2/2/0/e						BMETE11AX03-C
Free Elective Subjects											
Free Elective 1		4					4/0/0/e				
Free Elective 2		4						4/0/0/e			
Free Elective 3		4							4/0/0/e		
Free Elective 4		4							4/0/0/e		
Fundational Technical Studies											
Signals and Systems	BMEVIHVA214	5				3/1/0/p					BMETE90AX05-C
Electronics	BMEVIEEA307	4					3/1/0/p				BMETE11AX04*
Control Engineering	BMEVIIIA309	4					3/1/0/p				BMEVIHVA214-S
Digital Design 1	BMEVIMIA102	5	2/2/0/e								
Digital Design 2	BMEVIMIA111	5		2/2/0/e							BMEVIMIA102-C
Computer Architectures	BMEVIHIA210	5			2/2/0/e						BMEVIMIA111-C
Computer Networks	BMEVIIIA215	4				3/1/0/e					BMEVIHIA210*
Telecommunication Networks and Services	BMEVITMA310	4					3/1/0/e				BMEVIIIA215-S
Measurement Laboratory 1	BMEVIMIA211	2			0/0/2/p						BMEVIMIA102-C
Measurement Laboratory 2	BMEVIMIA216	2				0/0/2/p					BMEVIMIA211-C
Measurement Laboratory 3	BMEVIMIA312	2					0/0/2/p				BMEVIIIA215-S
Measurement Laboratory 4	BMEVIMIA315	2						0/0/2/p			BMEVISZA311-S BMEVITMA310
Basics of Programming 1	BMEVIEEA100	5	2/2/0/e								
Basics of Programming 2	BMEVIEEA112	4		2/2/0/p							BMEVIEEA100-C
Software Technology	BMEVIIIA217	4			3/1/0/e						BMEVIEEA100-S
Software Methods	BMEVIAUA218	4				3/1/0/e					BMEVIIIA217-C
Operation of Information Systems	BMEVITMA314	4						3/1/0/e			BMEVITMA310-C
Operating Systems	BMEVIMIA219	4				3/1/0/e					BMEVIHIA210-S
Databases	BMEVISZA311	5					3/1/0/e				BMEVISZA213-S
Artifical Intelligence	BMEVIMIA313	5					3/1/0/e				BMEVISZA213-S
Software Laboratory 1	BMEVIEEA101	2	0/0/2/p								
Software Laboratory 2	BMEVIEEA113	2		0/0/2/p							BMEVIEEA112*
Software Laboratory 3	BMEVIIIA212	2			0/0/2/p						BMEVIEEA112-C
Software Laboratory 4	BMEVIIIA220	2				0/0/2/p					BMEVIIIA217*
Software Laboratory 5	BMEVIMIA308	2					0/0/2/p				BMEVIMIA219-C
Specialization Studies											
Specialization Subject 1		5						3/1/0/e			
Scecialization Subject 2		5						3/1/0/e			
Specialization Subject 3		5							3/1/0/e		
Specialization Laboratory 1		2						0/0/2/p			
Specialization Laboratory 2		2							0/0/2/p		
Project Laboratory		3						0/0/6/p			
Thesis		15							0/10/0/s		

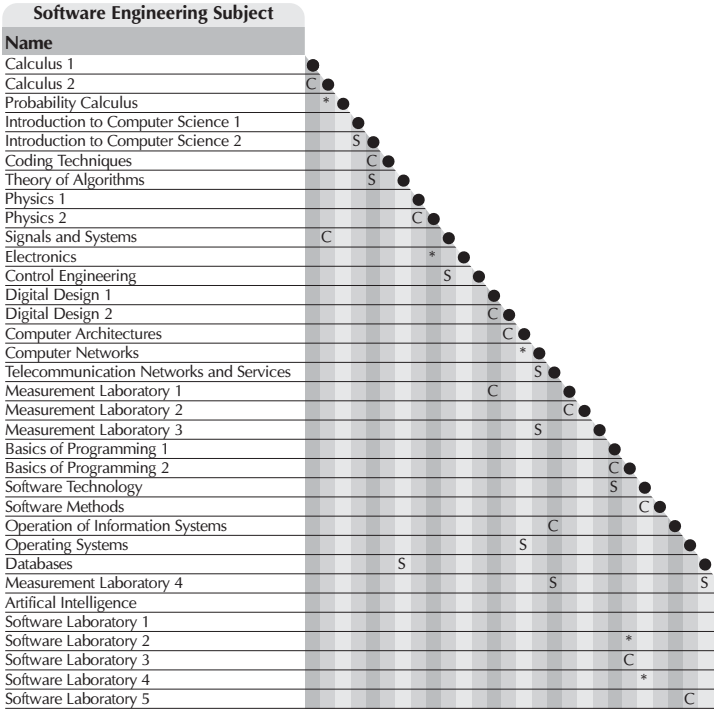
Pre-requisites for the B.Sc. Subjects

Electrical Engineering Subject



C: Credit required
S: Signature required
**: It can be taken earliest with the corresponding subject*

Software Engineering Subject



C: Credit required
S: Signature required
**: It can be taken earliest with the corresponding subject*

Curriculum of M.Sc. Subjects in Electrical Engineering

Subject			Working hours / semester				Requisites
Name	**Code**	**Credits**	**1**	**2**	**3**	**4**	
Communication Engineering Specialization							
Mathematics	BMETKVIM101	6	6				
Physics	BMETKVIM102	4	4				
Signals and Systems	BMETKVIM103	5	4				
Radio Systems	BMETKVIM104	5	5				
Electromagnetic Fields	BMETKVIM201	6		5			
Acoustics and Digital Signal Processing	BMETKVIM226	5		5			
Telecommunication	BMETKVIM203	5		5			
Network Theory	BMETKVIM301	7			7		
Computer Systems	BMETKVIM302	5			4		
Microelectronics	BMETKVIM303	5			4		
Elective I	BMETKVIMX..	4	4	4	4	4	
Elective II	BMETKVIMX..	4		4	4	4	
Project Laboratory I	BMETKVIM105	3	3				
Project Laboratory II	BMETKVIM204	3		3			
Project Laboratory III	BMETKVIM304	3			3		
Thesis	BMETKVIM402	30				16	
Computer and Control Engineering Specialization							
Mathematics	BMETKVIM101	6	6				
Discrete Mathematics	BMETKVIM106	5	4				
Foundations of Computer Science	BMETKVIM205	6	6				
Process Control	BMETKVIM109	5	4				
Digital System Design	BMETKVIM110	5	4				
Software Engineering	BMETKVIM212	5		4			
Information Processing	BMETKVIM206	5		4			
Robotics	BMETKVIM209	5		4			
Computer-Aided Engineering	BMETKVIM107	5		4			
Machine Intelligence	BMETKVIM305	5			4		
Circuit Design	BMETKVIM112	5		4			
Data and Computer Networks	BMETKVIM310	5			4		
Measuring Systems	BMETKVIM324	5			4		
Process Instrumentation	BMETKVIM111	5			4		
Computer Systems	BMETKVIM302	5			4		
Elective I	BMETKVIMX..	4				4	
Elective II	BMETKVIMX..	4				4	
Project Laboratory I	BMETKVIM105	3	3				
Project Laboratory II	BMETKVIM204	3		3			
Project Laboratory III	BMETKVIM304	3			3		
Thesis	BMETKVIM402	30				16	
Power Engineering Specialization							
Mathematics	BMETKVIM101	6	6				
Network Theory	BMETKVIM117	2	2				
Thermal Systems	BMETKVIM118	5	4				
Digital Systems	BMETKVIM119	5	4				
Control Engineering	BMETKVIM120	5	4				
Power Electronics	BMETKVIM216	5		4			
Electrical Machines	BMETKVIM217	5		4			
Power System Operation and Control	BMETKVIM218	5		4			
Electromagnetic Fields	BMETKVIM314	3			2		
Electric Drives	BMETKVIM315	8			8		
Elective I	BMETKVIMX..	4		4	4	4	
Elective II	BMETKVIMX..	4			4	4	
Electrical Laboratory I	BMETKVIM121	3	4				
Electrical Laboratory II	BMETKVIM219	5		8			
Electrical Laboratory III	BMETKVIM316	5			8		
Project Laboratory I	BMETKVIM105	3	3				
Project Laboratory II	BMETKVIM204	3		3			
Project Laboratory III	BMETKVIM304	3			3		
Thesis	BMETKVIM402	30				16	

Curriculum of M.Sc. Subjects in Electrical and Software Engineering

Subject			Working hours / semester				Requisites
Name	Code	Credits	1	2	3	4	
M.Sc. Elective Subjects for All Programs							
Power Semiconductor Devices	BMETKVIMX04	4	4				
Semiconductor Memories	BMETKVIMX05	4	4				
Device Physics of VLSI and ULSI Integr. Circ.	BMETKVIMX06	4	4				
Advanced Comp. and Parallel Architectures	BMETKVIMX08	4	4				
Simulation	BMETKVIMX09	4	4				
Biomedical Instruments	BMETKVIMX10	4	4				
Biomedical Engineering	BMETKVIMX11	4	4				
Robot Control	BMETKVIMX13	4	4				
Advanced Computer Networks	BMETKVIMX14	4	4				
Thyristor AC Drives	BMETKVIMX15	4	4				
Lightning Protection	BMETKVIMX18	4	4				
Electromagnetic Compatibility	BMETKVIMX19	4	4				
Computer-Aided Design of Electr. Machines	BMETKVIMX20	4	4				
Special and Micro-machines	BMETKVIMX21	4	4				
Measurement of Electrical Machines	BMETKVIMX22	4	4				
Optical Communication	BMETKVIMX24	4	4				
Numerical Electromagnetic Field Analysis	BMETKVIMX27	4	4				
Radio Measuring Systems	BMETKVIMX28	4	4				
Radiowave Propagation and Digital Comm.	BMETKVIMX29	2	2				
Video and Sound Systems	BMETKVIMX30	4	4				
Basics and Application of Technical Acoustics	BMETKVIMX31	4	4				
Queuing Systems	BMETKVIMX32	4	4				
High-level Logic Synthesis	BMETKVIMX33	4	4				
Microprogrammed Logic Circuit Design	BMETKVIMX34	4	4				
Advanced Soft Computing	BMETKVIMX36	4	4				
Pulse Width Modulation (PWM) in Electrical Drives and Power Supplies	BMETKVIMX37	4	4				
Microcomputer Controlled Electrical Drives	BMETKVIMX38	4	4				
Non-Conventional Energy Converters	BMETKVIMX39	4	4				
Physical Principles and Engineering Applications of Superconductors	BMETKVIMX40	4	4				
Control Systems Engineering I	BMETKVIMX41	4	4				
Control Systems Engineering II	BMETKVIMX42	4	4				
Advanced Control Theory and Design	BMETKVIMX43	4	4				
Industrial Instrumentation Fundamentals	BMETKVIMX45	4	4				
Power System Protection	BMETKVIMX46	4	4				
Multichip Modules	BMETKVIMX50	4	4				
Sensor Technologies and Applications	BMETKVIMX51	2	2				
Digital Signal Processing Solutions	BMETKVIMX53	4	4				
High Power Switching	BMETKVIMX54	4	4				
High Voltage Engineering	BMETKVIMX55	4	4				
Internet New Generation	BMETKVIMX56	4	4				
Application of Internet Databases in Circuit Design	BMETKVIMX59	4	4				
Production Informatics	BMETKVIMX60	4	4				
VHDL Application in Circuit Design	BMETKVIMX61	4	4				
Public Wireless Networks	BMETKVIMX63	4	4				
Active Networks	BMETKVIMX64	4	4				
Media Communications	BMETKVIMX65	4	4				
Numerical Methods I	BMETKVIMX52	4	4				
Numerical Methods II	BMETKVIMX57	4	4				
Data Protection and Freedom of Information	BMETKVIMX66	4	4				
Design of Power Electronics	BMETKVIMX97	4	4				
Control of Power Electronics Converters	BMETKVIMX62	4	4				
Power Generation by Solar Cells	BMETKVIMX72	4	4				
C++ Programming	BMETKVIMX76	4	4				
Advanced Technology of Broadcasting	BMETKVIMX78	4	4				
Technology of Digital Broadcasting	BMETKVIMX79	4	4				
Engineering Problem Solving	BMETKVIMX75	4	4				
Microwave Sensors	BMETKVIMX73	4	4				
Building Management Systems	BMETKVIMX74	4	4				
Distributed Enterprise Systems	BMETKVIMX67	4	4				
Software Development Processes	BMETKVIMX68	4	4				
Modelling of Multicast Transport	BMETKVIMX70	4	4				
Theory and Application of Superconductors	BMETKVIMX71	4	4				
Microprogrammed System Design	BMETKVIMX69	4	4				
Performance Evaluation Tools	BMETKVIMX77	4	4				
Computer Telephony Integration	BMETKVIMX80	4	4				
Global System for Mobile	BMETKVIMX81	4	4				
Analysis of Signals	BMETKVIMX82	4	4				
Internet Based Communication	BMETKVIMX83	4	4				
Mathematical Statistics and random Processes	BMETKVIMX84	4	4				

Curriculum of M.Sc. Subjects in Electrical and Software Engineering

Subject			Working hours / semester				Requisites
Name	**Code**	**Credits**	**1**	**2**	**3**	**4**	
M.Sc. Elective Subjects for All Programs (contd. from previous page)							
Windows Programming in Delphi	BMETKVIMX85	4	4				
Development of Multimedia	BMETKVIMX86	4	4				
Wideband Antennas	BMETKVIMX87	4	4				
Surface Penetrating Radars	BMETKVIMX88	4	4				
Predictive Control for Linear and Nonlinear Systems	BMETKVIMX89	4	4				
Control of Electrical Machines and Drives	BMETKVIMX90	4	4				
Protocols for Telecommunication Networks	BMETKVIMX91	4	4				
Satellite Broadcasting Theory and Measurem.	BMETKVIMX92	4	4				
Telecommunications Management	BMETKVIMX93	4	4				
CATV-Electronics	BMETKVIMX94	4	4				
Modelling and Design of Fast Arithmetic Syst.	BMETKVIMX95	4	4				
ATM Networks	BMETKVIMX96	4	4				

Curriculum of M.Sc. Subjects in Software Engineering

Subject			Working hours / semester				Requisites
Name	**Code**	**Credits**	**1**	**2**	**3**	**4**	
System and Software Development Specialization							
Computer Graphics and Image Processing	BMETKVIM122	5	4				
Object Oriented Development	BMETKVIM123	5	4				
Software Techniques and Tools	BMETKVIM124	5	4				
Concurrent and Distributed Programming	BMETKVIM125	5	4				
Data Security	BMETKVIM126	5	4				
Distributed Systems	BMETKVIM220	5		4			
Design of Web Interfaces	BMETKVIM318	5		4			
Software Quality Control and Management	BMETKVIM221	5			4		
Database Design	BMETKVIM225	5		4			
Data Presentation	BMETKVIM224	5		4			
Embedded Systems	BMETKVIM317	5			4		
System Integration	BMETKVIM222	5		4			
Integrated Information Systems	BMETKVIM319	5			4		
Data Mining	BMETKVIM321	5			4		
Soft Computing	BMETKVIM323	5			4		
Elective I	BMETKVIMX..	4				4	
Elective II	BMETKVIMX..	4				4	
Project Laboratory I	BMETKVIM105	3	3				
Project Laboratory II	BMETKVIM204	3		3			
Project Laboratory III	BMETKVIM304	3			3		
Thesis	BMETKVIM402	30				16	

Description of B.Sc. Subjects in Electrical Engineering
Elements of Natural Science

Mathematics A1

BMETE90AX00

Dr.Dénes Petz
(6 credits)

Mathematics A2

BMETE90AX02

Dr.Lajos Rónyai
(6 credits)

Mathematics A3

BMETE90AX09

Dr.József Fritz
(4 credits)

Mathematics A4

BMETE90AX08

Dr.Bálint Tóth
(4 credits)

Physics 1

BMETE11AX01

Dr.Pál Pacher

MECHANICS: Measurements, units, models in physics. Space, time, different frames of references. Motion of a particle in 3D. Newton's laws. Work, kinetic energy, potential energy. Work-energy theorem. Conservation laws in mechanics. Motion in accelerated frames, inertial forces. Newton's law of gravitation. Basics of the theory of special relativity. System of particles, conservation laws. Kinematics and dynamics of a rigid body. Oscillatory motion, resonance. Wave propagation, wave equation, dispersion, the Doppler-effect.

THERMODYNAMICS: Heat and temperature. Heat propagation. Kinetic theory of gases. Laws of thermodynamics. Reversible and irreversible processes, phase transitions. Entropy, microscopic interpretation of entropy. Elements of statistical physics.

STATIC ELECTRIC AND MAGNETIC FIELDS: Electric charge. Electric field, electric flux, electric potential. Basic equations of electrostatics. Applications of Gauss's law. Capacitors, energy of the static electric field. Dielectrics, boundary conditions.

Electric current. Magnetic field. Current carrying wire in magnetic field. Magnetic field produced by an electric current, the Biot-Savart law. (5 credits)

Physics 2

BMETE11AX02

Dr.Pál Pacher

ELECTRODYNAMICS: Faraday's law. Self induction, mutual induction. Magnetic properties of matter. Magnetic data storage. Maxwell equations. Generation, propagation and reflection of electromagnetic waves. Basics of geometrical optics. Wave optics, interference, diffraction. Polarised light.

BASICS OF ATOMIC PHYSICS: Natural and coherent light sources. Physical foundations of optical communication. Matter waves of de Broglie. The Schrödinger equation. The electron structure of atoms. Electron spin. Free-electron theory of metals. Band structure of solids. Superconduction. Quantum-mechanical phenomena in modern electronics. Basics of nuclear physics. Nuclear reactors. Elementary particles. Curiosities in cosmology. (5 credits)

Foundation of Computer Science

BMEVISZA105

Dr. András Recski

Basic concepts of combinatorics (permutations, variations, combinations). Basic concepts of graph theory (vertex, edge, degree, isomorphism). Path, circuit, connectivity, trees. Planar graphs, duality.

Algorithms in graph theory (minimum cost tree, shortest path, maximum matching, flow problems, topological sorting, PERT method). Higher connectivity numbers of graphs. Graph colouring problems (vertex, edge and map colouring). Euler- and Hamiltonian circuits.

Basic concepts of algorithms and complexity. Polynomially solvable and NP-complete problems.

Basic concepts in number theory (divisibility, primes, congruences, Euler-Fermat theorem), algorithms in number theory (prime tests, public key criptography).

Basic concepts of abstract algebra (operations, structures), semigroups. Groups, their relations to transformations, important special groups, factor group. Rings and fields. (6 credits)

Material Science

BMEGEMTAV01

Dr.László Dévényi
(4 credits)

Software Engineering 1

BMEVIIIA202

Dr.Károly Kondorosi

Computer Architectures: Typical units and block-diagram of computers. CPU, memory, I/O controllers, connections, integrated solutions, motherboards and extensions. Software model of a CPU, characteristic parameters, performance. Possibilities of improving performance, advanced architectures. Structuring and managing the main memory. Hardware support for multitasking. Overview of a typical simple CPU (e.g. Intel 386). Peripherals, I/O subsystem, controllers. Multiprocessor systems, loosely and tightly coupled architecture. Modularisation, bus systems. Bus controllers, control policies on multi-master buses.

Operating Systems: Historical overview, stages of the evolution. Basic concepts and principles: multiprogramming, processes, system of multiple processes, cooperation and competition, communication and synchronisation. Deadlock situations. Multiprogramming: processes and threads in a single processor system, queuing and state model of OS. CPU scheduling. Memory management and virtual memory. File-system, I/O system, disk scheduling. Networking and distributed systems. Case-studies: Windows, Linux and Unix. (5 credits)

Software Engineering 2

BMEVIAUA203

Dr.István Vajk

Computer networks: Basic concepts, network topologies, network structures, network architectures (OSI and TCP/IP models). Communication channel. Error-correction and error-control coding. End-to-end connection. Connection-based and connection lost data transmission. Services. IEEE 802.3 and Ethernet. TCP/IP protocol.

Database design: Basic concepts. Architecture of a data-

base management system. Logical databases. Relational data model. Key, functional dependencies, normal forms, relational algebra. Physical databases, indexing techniques. Logical planning of relational databases. The SQL language.

Formal languages: Basic concepts, languages, grammatik, automata, Chomsky hierarchy. Finite state machines and regular languages. Context-free and LL(k) languages. Compilers. (5 credits)

Description of B.Sc. Subjects in Electrical Engineering
Fundational Technical Studies

Basics of Programming 1

BMEVIHIA106

Dr.László Jereb

Basic concept of solving problems with computer: program, algorithm, specification, algorithm design. Fundamental concept of programming in high level languages: elements of languages, statements, data structures, control structures, loops. Construction of simple algorithms: sorting, searching, recursion, recursive data structures. Design, coding, debugging, segmentation, functional decomposition. (5 credits)

Basics of Programming 2

BMEVIHIA107

Dr.László Jereb

Improvement of skills in high level programming languages. Collaboration of programs and modules written in different languages. Using operation system services. Design methods, software development tools. Basics of object oriented programming. Basics in efficiency analysis of algorithms. Solving large scale computer problems. Program design for portability. (4 credits)

Digital Design 1

BMEVIIIA104

Dr.Péter Arató

Basic logic design principles. Analog versus digital signal processing. Boole algebra, number systems. Basic models of combinational and sequential systems.Truth-table representation of combinational systems. Switching functions, disjunctive and conjunctive canonical forms. Building blocks of combinational systems (gates). Minimization of switching functions on Karnaugh map. (Disjunctive and conjunctive minimal two-level realisations, handling of don't care minterms). The Quine-McCluskey method. Optimal cover algorithm for selection from prime implicants. Multiple-output minimization. Transient behavior and timing of combinational systems (static, dynamic and functional hasards and their elimination). Special problems of symmetric switching functions. Classification of sequential systems as state machines (asynchnronous and synchronous realisations, Mealy- and Moore-models). State table and state diagram. Flip-flops as building blocks (SR, JL, T, DG and D flip-flops). Design steps of synchronous state machines (constructing the preliminary state table, state reduction, state assignment). Clock skew and its elimination by applying data-lock-out flip-flops. Special problems with the design of asynchronous state machines (avoiding critical races and essential hazards). Practical realisation of flip-flops. (simple edge-triggered, master-slave, data-lock-out structures). Metastable states. Applying MSI chips for designing functional units. Multiplexers, demultiplexers, decoders counters, shift registers, arithmetic units and comparators. Static and dynamic RAM units, read-only memory units (ROM) and their application int he design. Microprogrammed control. Application-specific units (ASIC). PLA and FPGA units and their application. Basic principles of hardware description languages (VHDL and VERILOG and their comparison). (7 credits)

Digital Design 2

BMEVIIIA108

Dr.Péter Arató

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. (5 credits)

Systems and Signals 1

BMEVIHVA109

Dr. Imre Sebestyén

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 resistrors, 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. (6 credits)

Systems and Signals 2

BMEVIHVA200

Dr. Imre Sebestyén

Complex frequency, Laplace-transforms. Transfer function. Pole-zero pattern. Calculation of the response. Review of system functions. Allpass and minimum-phase systems. Non-linear resistive networks, determination of the operating point. Operating line. Dynamic networks. Linearization at the operating point. Piece-wise linearization. Numerical solution methods (Euler). Discrete-time signals, systems and networks. System equation; step-by-step solution; free and excited solution decomposition. Impulse and step excitations. Impulse response and its application, convolution. Input-output stability (BIBO). State variable descripiton and its solution methods. Asymptotic stability. System equation. Solution of the system equation and of the state variable description, connection between them. Signal flow networks, construction of the state variable description. Sinusoidal steady state, phasor description. Transfer characteristic. Network analysis. Fourier representation of periodic discrete-time signals. Spectral representation of disrete-time signals, Fourier transformation. Analysis of discrete-time signals, systems and networks in the complex frequency domain, z-transforms. Transfer function, pole-zero pattern. Finite impulse response, allpass and minimum-phase systems. Network analysis. (6 credits)

Electromagnetic Fields

BMEVIHVA204

Mrs. Dr. Amália Iványi

Transmission lines, sinusoidal steady-state, transient phenomena. Electric charge and current. Electric field strength, magnetic flux density. El;ectric and magnetic potential. Electric flux density, magnetic field strength. Linear and nonlinear 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. (5 credits)

Electronics 1

BMEVIHIA205

Dr.László Pap

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, monostabil multivibrator. Oscillators, square-wave relaxation oscillator, astabil 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. (6 credits)

Electronics 2

BMEVIHIA300

Dr.László Pap

Noise in electronic devices, noise bandwidth, power density spectrum, probability density function of the noise signal. Thermal noise, flicker noise, etc. Equivalent noise circuits of the electronic devices, equivalent input and output noise of the amplifiers. Noise figure. The phase-locked loops and their applications. Structure, linear small signal baseband model, different types of the PLL-s. Analysis of the linear baseband model. FM modulator and demodulator. Clock signal generators, jitter. Selective electronic circuits. Specification, approximation, tolerance scheme, transformations. Active RC circuits, switched capacitor selective circuits, resonant filters (LRC circuits, ceramic filters, etc.). Nonlinear circuit: rectifiers, limiters, piecewise linear circuits. Logarithmic and exponential amplifiers. Circuits of mixers and frequency transpose. Modulators and demodulators. Basic knowledge of energy conversion techniques. Power rectifiers, DC regulators: analog and switch-mode circuits. DC- DC and DC-AC converters. Overcurrent protection. Thyristors and their applications, new power electronic semiconductor devices and modules. Tree phase rectifiers, power converters. Power efficiency of the electronic circuits. Problems of the implementation. Description of passive distributed circuits in the time and frequency domain. Modeling and design of active analog circuits with distributed reactive elements (very high frequency amplifiers, oscillators, mixers, etc.). Microelectronic implementation of distributed circuits. High frequency integrated circuits (oscillators, power attenuators, etc.). Thermal problems of the electronic circuits, methods of heat removal. Conduction, convection, radiation. Thermal resistance and capacitance. Cooling methods, heat pipe. Thermal design of electronic devices with CFD. Heat sink of mobile equipment. (6 credits)

Microelectronics

BMEVIEEA306

Dr. János Mizsei

The main purpose of this subject is to fill the gap between the abstract electronic functions and the physical reality. Basic knowledge will be given by lectures on material science, physics of semiconductors (fundamental properties, doping, majority and minority carriers, basic equations), physiscs, properties and characteristics of electron devices (pn junctions, diodes, bipolar and MOS transistors, junction FETs, thyristors, photovoltaic devices, functional devices included small and large signal behaviour), equivalent circuits and models of electron devices, thermal effects, solide state integrated circuits (bipolar, MOS, BiCMOS), microsystems, relation between construction and technology, realisation of active and passive elements, semiconductor technology from the sand to the encapsulated IC chip (oxidization, photolithography, diffusion, ion implantation, metallization, encapsulation and testing), roadmaps of technology, scale down effects, limits of integration, nanoelectronics. Based on earlier subjects (Electronics I-II) the integrated realisation of the analog and digital circuits will be discussed (operational amplifiers, A/D, D/A converters, inverters, logic gates). Important part of this subject is to exercise and train the students for numerical calculations and to demonstrate some case studies. Practical knowledge will be given through laboratory exercises on the computer modelling of electron devices and circuits, CAD tools for IC design too. (5 credits)

Measurement Technology

BMEVIMIA206

Dr.Gábor Péceli

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. (5 credits)

Electric Power Systems

BMEVIVEA207

Dr. György Varjú

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. Modelling 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 earthing and their effects on the earth fault currents and over-voltages. Applied neutral earthing 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. (5 credits)

Infocommunications

BMEVITMA301

Dr. Géza Gordos

The overall objective of the course is to give an overview about the major sub-topics, methods and solutions characterizing telecommunications in the broadest possible sense of the word. The treatment of the various types of messages (sound/voice, image, video, data) and their basic processing (sampling, digitazing, compression, error correction) is followed by getting acquainted with the transmission channels (copper, fiber, radio) and with the analoge and digital modulation methods that couple messages and chanels. A chapter on infocommunications networks embraces circuit and packet (e.g. IP) based communications and their implementations in legacy and new generation wireline and wireless networks and sevices. Audio and video broadcasting by analog and digital methods using terrestial, satelite and cable facilities concludes the syllabus. (5 credits)

Electronics Technology

BMEVIETA302

Dr. Gábor Harsányi

Lectures: Classification of electronic products and technologies; types forms, and assembling methods of electronic components; interconnection substrates of circuit modules, materials and technologies; printed wiring boards (PWBs), insulating substrate passive (thin- and thick-film) networks and high density interconnects; design methods and considerations; mounting and assembling methods of circuit modules; design and application of combined (optoelectronic and mechatronic) modules; basics of appliance design; quality, reliability, environment and other human oriented issues of electronics technology.

Laboratories: technology of double sided printed wiring boards with through-hole metallization; film deposition technologies of thick film circuits: screen-printing and firing. film deposition and patterning technologies of thin film networks: vacuum evaporation, photolithography and etching; laser processed applied in electronics technology; through-hole mounting of circuit modules; surface mounting of circuit modules. (5 credits)

Control Theory

BMEVIAUA303

Dr.Jenő Hetthéssy

Theory: Basic control principles. Control structures. Specifications prescribed for control systems. Deterministic analysis of continuous-time linear control systems in the time-, operator- and frequency domain. State space representation of control systems. Solution of the state equation. State transformations. Controllability and observability. Static behavior and transient response, tracking and regulation properties. Stability analysis. Design of continuous control system. Design considerations in the time- and in the frequency domain. PID control algorithms. Cascade control. State feedback control. Extension of state feedback by integrator state. State estimation. State feedback from the estimated state variables. Analysis of discrete-time (sampled data) control systems. The structure of discrete control systems. The choice of the sampling time. Analysis of discrete-time linear control systems in the time-, operator- and frequency domain. Design of discrete control systems. Discrete PID control algorithms. Dead-beat controller design. Smith predictor. Realization of digital controllers.

Computer laboratory exercises: Matlab/Simulink based computer laboratory exercises support the understanding of the theoretical material and contribute to develop problem solving capabilities. (5 credits)

Electrotechnics

BMEVIVEA201

Dr. István Vajda

The process of electrical energy supply (from the power station to the consumer). Generation of electrical energy (sources). The tools of transmission of electrical energy (symmetrical three phase transmission). Distribution of electrical energy, consumers' systems. Engineering calculation methods of symmetrical three phase networks. Properties of conducting and magnetic electrotechnical materials. Calculation of magnetic circuits. Operational principles of one and three phase transformers. Principles and methods of generating rotational and translational magnetic fields. Torque production of rotating electrical machines. Design principles and operation of electrical energy converters. Introduction into electrical drives. Modelling and design principles of electromagnetic devices. Physiological effects. Prospects of electrical energy. (6 credits)

Description of B.Sc. Subjects
Specialization Studies

Laboratory 1

BMEVIMIA304

Dr.Tamás Dabóczi

The primary aim of this laboratory course is to improve the skills of the students on the following areas:

- get acquainted with the materials, components and instruments in the area of electrical engineering,
- practice the designing of measurement setups, setting up the measurement, measuring and using the infrastructure of the laboratory,
- practice the evaluation and documentation of the measurement results.

The topics of the measurements:

1. measurement: Get to know the instruments
2. measurement: Basic measurements
3. measurement: Basic digital tools
4. measurement: Signal analysis I.
5. measurement: Signal analysis II.
6. measurement: Investigation of two poles
7. measurement: Investigation of four poles
8. measurement: Investigation of active electronic devices
9. measurement: Investigation of logic circuits
10. measurement: Investigation of synchronous devices
11. measurement: Measurement of programmable peripheries

(5 credits)

Laboratory 2

BMEVIMIA305

Dr.Tamás Dabóczi

The Laboratory 2 course is the continuation of Laboratory 1. As such the laboratory aims at further improving the skills of the students in the field of practical knowledge of electrical engineering.

- they improve their knowledge of materials, components and instruments in the area of electrical engineering,
- improve their practice in designing of measurement setups, setting up the measurement, measuring and using the infrastructure of the laboratory,
- improve their practice of evaluation and documentation of the measurement results.

The topics of the measurements:

1. measurement: Building and testing simple electrical circuits
2. measurement: Designing printed circuit boards
3. measurement: Measurement of EMC phenomena
4. measurement: Measurement of electrical power
5. measurement: Investigation of transistor amplifiers
6. measurement: Investigation of instrumentation amplifiers
7. measurement: Investigation of ADC and DAC
8. measurement: System identification and control
9. measurement: Investigation of analog phase locked loop
10. measurement: Investigation of a 900 MHz FSK transceiver/receiver
11. measurement: Logic controllers

(5 credits)

Description of B.Sc. Subjects in Software Engineering
Elements of Natural Science

Calculus 1

BMETE90AX04

Mrs. Dr. Józsefné Fritz

(7 credits)

Calculus 2

BMETE90AX05

Mrs. Dr. Józsefné Fritz

(7 credits)

Probability Calculus

BMEVISZA208

Dr. Györfi László

Probability: Elements (random experiment, outcomes, sample space, event, probability). Conditional probability, independence of events. The law of total probability and Bayes' rule. Random variables, probability distribution function. Discrete random variables (binomial, geometric, Poisson, hypergeometric). Continuous random variables (uniform, exponential, normal). Expectation and variance. Markov's and Chebyshev's inequalities. Joint distributions and independence. Covariance and correlation coefficient. Linear regression. Law of large numbers. Central limit theorem.

Statistics: Elements (sample, estimators, unbiased and consistent estimators). Confidence intervals (examples in normal data). Statistical tests (null hypotheses, type I and type II errors, test statistics, critical value, the u- and t-tests). (4 credits)

Introduction to Computer Science 1

BMEVISZA103

Dr. András Recski

Scalars, vectors, analytic geometry of the 2- and 3-dimensional space. Solvability of systems of kinear equations with Gauss elimination. Unicity. Determinants, their properties. Complex numbers. Vector spaces, linear independence, base, dimension. Linear transformations and their matrices, rank, inverse. Eigenvalues and eigenvectors of linear transformations. Quadratic forms, definiteness.

Equivalence and cardinality of infinite sets. Countable and continuum. Power set.

Basic concepts of combinatorics (permuttions, variations, combinations). Basic concepts of graph theory (vertex, edge, degree, isomorphism). Path, circuit, connectivity, trees. Planar graphs, duality. (5 credits)

Introduction to Computer Science 2

BMEVISZA110

Dr. András Recski

Algorithms in graph theory (minimum cost tree, shortest path, maximum matching, flow problems, topological sorting, PERT method). Higher connectivity numbers of graphs.

Graph colouring problems (vertex, edge and map colouring). Euler- and Hamiltonian circuits.

Basic concepts in number theory (divisibility, primes, congruences, Euler-Fermat theorem), algorithms in number theory (prime tests, public key criptography).

Basic concepts of abstract algebra (operations, structures), semigroups. Groups, their relations to transformations, important special groups, factor group. Rings and fields. (4 credits)

Coding Techniques

BMEVIHIA209

Dr. István Vajda

Objective: Clear understanding of the basic principles, notions, models, techniques in the field of data compression coding, error control coding, and cryptography security encoding, supported by solving lots of numerical problems. The aim is to develop the ability to apply basic techniques and solve standard design problems.

Data compression coding: Prefix code. Average codeword length and the entropy. Shannon-Fano code, Huffmann code, Lempel-Ziv code. Quantization. Uniform quantization. Lloyd-Max quantizer. Transformation encoder. Predictive encoding. Voice compression. Video compression.

Error control coding: Basic notions of error control (code, codeword, error models, Hamming distance, error correction, error detection, code distance, code parameters). Binary linear code: generator matrix, parity check matrix, systematic code. Hamming code. Cyclic linear code, generator polynomial, parity check polynomial. CRC detection technique. Nonbinary linear codes. Reed-Solomon code. Encoding of the CD. Code combination techniques (product code, interleaving, cascading). Convolutional code, Viterbi decoding technique.

Security coding: Basic notions, encryption, authentication, integrity protection, access control, repudiation. Ideal encryption. Linear encryption. Public key encryption. RSA algorithm. Hash functions. Basic cryptographic protocols: party authentication, integrity protection, key distribution, digital signature, key certificate. Typical security holes in cryptographic primitives and protocols.

(5 credits)

Theory of Algorithms

BMEVISZA213

Mrs. Dr. Katalin Friedl

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 conquere, dynamic programming. Efficient approximation algorithms. Algorithmically hard problems, the notion of NP and NP-completeness.

(5 credits)

Physics 1

BMETE11AX03

Dr.György Mihály

(4 credits)

Physics 2

BMETE11AX04

Dr.György Mihály

(4 credits)

Description of B.Sc. Subjects in Software Engineering
Fundational Technical Studies

Signals and Systems

BMEVIHVA214

Dr. Árpád Bokor

Definition of signals, systems and networks. Classification. Causality, linearity, invariancy. 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 stasbility. 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 (allpass, minimumphase FIR) systems. DT simulators of CT systems. (5 credits)

Electronics

BMEVIEEA307

Mrs. Dr. Márta Kerecsen-Rencz

Introduction to the history of electronics. The present status and trends in microelectronics. Introduction to physics and circuit theory. Calculation of RC circuits. The Bode diagram. The properties of semiconductor material, calculation of charge carrier densities. Calculations of currents in semiconductors, the continuity equations. The operation of the p-n junction and the major applications. SPICE modeling and hand calculation methods. Basic logic circuits with diodes. Calculation of circuits containing diodes. The operation of control sources, the physics of the bipolar transistor, characteristics. Finding the operating point of the bipolar transistor, calculations with simple amplifier circuits. Secondary effects in the operation. The major characteristics of field effect transistors. The physics of the MOS capacitor, the operation of CCD cameras. Discussion of the types, models, and use of the MOS transistors, major advantages. The basics of integrated circuits. The role and predictions of roadmaps in microelectronics. Introduction to the fundamentals of VLSI manufacturing. The element set of MOS circuits. The properties of interconnects. The element set of bipolar and BiCMOS circuits. The fundamentals of digital circuits. General characteristics of inverters and basic MOS logical gates. Construction of complex logical gates. The fundamentals of CMOS circuits, basic logic gates and complex gates. The use of transfer gates in MOS and CMOS circuits. Combinational logic with different CMOS realizations, driver circuits I/O circuits, pulse generators and storage elements. The main structures of registers and arithmetic elements. The fundamentals of testing digital circuits. The operation, classification and main parameters of semiconductor memories. The basics of analogue integrated circuits, operational amplifiers, real and ideal amplifiers, circuits with operational amplifiers. A/D and D/A converters. The categories of application specific integrated circuits (ASIC). The design methodologies of integrated circuits. Graphic peripheral devices; CRT, LCD, plasma displays. Micro-electro-mechanical (MEMS structures). (5 credits)

Control Engineering

BMEVIIIA309

Dr.Béla Lantos

Modelling and system enginering description of processes: Equilibrium points of nonlinear systems, linearization. State equation of dynamical systems, computation of the transients. Transfer function, poles and zeros, frequency functions, Nyquist and Bode diagrams.

Fundamental ideas of control engineering: The principles of control, feedback control and open loop control. Blokkdiagram algebra and transformations. Set pont control and reference signal tracking, the role of negative feedback. Expectations for actuators and sensors, standard signal domains. Performancies of control systems. Stability criterions. Idea and application of root locus. General algebraic (polynomial) design methods: Youla parametrization. Approximating inverses. Control of stable and unstable systems. Application of Diophantine equation. Different types of two degree of freedom control structures (IMC: internal model control). Synthesis of continuous time control systems: Closed control loop, open loop, loop gain, type number. PID controller. Controller parameter design for prescribed steady-state accuracy and phase margin. Control of dead time systems. Robustness investigation of control systems, sensitivity functions. The effect and handling of saturations. Digital control systems: Sampling theorem of Shannon, holding elements. Discrate time transfer function. Transfer functions and pole-zero configurations of typical elements. Discrete time PID control algorithms. Discrete time controller design based on continuous time methods. Saturation handling. Control systems in state space: Controllability and observability. Pole assignement by using state feedback, state observer design in continuous and discrete time. Properties of the equivalent closed loop control system. Two step design. Outlook: Process identification, optimal and robust control design, adaptive control. The subject consists of lectures (3 hours/week) and 6 excercises (2 hours in every second week). During the exercises typical control system analysis and synthesis tasks will be solved using digital computer and MATLAB™ (Control System Toolbox™). (4 credits)

Digital Design 1

BMEVIMIA102

Dr.Endre Selényi

Basis of coding theory, number systems. Boolean algebra and switching functions. Combinational logic design principles and practices: Karnaugh maps, minimization methods, static and dynamic hazards. Logic gates realization. Synchronous sequential logic design principles and practices: state-machine structure, state minimization, state assignment. Asynchronous sequential logic design principles: state reduction and assignment, race problems and hazards. Realization with flip-flops and logic gates. (5 credits)

Digital Design 2

BMEVIMIA111

Dr.Endre Selényi

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. (5 credits)

Computer Architectures

BMEVIHIA210

Dr. Gábor Németh

Notion of computer architecture; relation of hardware and software. Traditional computer architectures. Characteristic

processor families. Memory management methods: block switching, indexed mapping, virtual memory management, cache memory. Reduced instruction set computer (RISC). Superscalar architectures. Periphery handling methods: device level and logical level handling. Multiprocessor structures: loosely coupled and tightly coupled multiprocessor systems. Coprocessors. Ordering of events. Logical clocks, partial and total ordering, abnormal behaviour. Physical clock, synchronizing conditions. Multiprocessing and multitasking: task handling, protection mechanism, cooperation of the user task and operating system. Fine grained parallelism. Harvard architecture, instruction and data pipelines, array processors. Information processing models: control driven, data flow, demand driven and information driven processing. Instruction level and procedural level data flow architectures. Intelligent networks. Neural networks and associative computers. Functional specification methods. Orthogonality, inheritance rules. Partitioning of the design model based on functional, information hiding and design-for-test. (5 credits)

Computer Networks

BMEVIIIA215

Dr. József Harangozó

Fundamentals in Computer Networks. Classification. History. Standardization. Convergence. Communication of Remote Processes. Modeling. 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 swithed 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. (4 credits)

Telecommunication Networks and Services

BMEVITMA310

Dr Tamás Henk

Architecture of telecommunication networks. Network hierarhies, numbering plans, signalling systems and signalling protocols. Telecommunication technologies: wired and wireless access, backbones. Plesiochronous Digital Hierarcy, Syncron Digital Hierarchy, Asyncronous Transfer Mode and optical networks. Telecommunication systems: Public Switced Telephone Networks, Global System Mobile, Voice over IP. Convergence of telecommunication-, computer- and broadcast networks. Software and hardware elements of telecom systems. Telecom software technology. Specification of telecom software. Infocom services. Teleservices. Message, data, voice and conference services. Content services. Video on Demand, Internet services. Web portals and services, media information systems, electronic commerce, electronic civic centre. Broadband integrated services. Autentication, authorization, and accounting. (4 credits)

Measurement Laboratory 1

BMEVIMIA211

Dr.János Hainzmann

Oscilloscope usage practice for investigation of digital circuits. Important characteristics of logic gates and signal-cables. Use of logic state-analyser for monitoring logic networks. Trouble-shooting in digital devices. The Verilog hardware description language, and its use for behavioural description of digital networks. Designing a simple sequential network for FPGA implementation using HDL language, testing of the implemented design. (2 credits)

Measurement Laboratory 2

BMEVIMIA216

Dr.János Hainzmann

In the laboratory the students get familiar with a state of the art microcontroller system. Use of an integrated development system. Writing of simple assembly programs for I/O handling. Peripheral management with polling and with interrupt. Comparing routines written in assembly and in C language. Services of a simple real-time operating system. (2 credit)

Measurement Laboratory 3

BMEVIMIA312

Dr.János Hainzmann

Testing the characteristics of A/D and D/A converters. Measurement of data channel characteristics. Investigation of simple data transfer protocols. Configuration of a PC for network connection. Creating a computer network by a manageable switch, investigation of the network. (2 credits)

Measurement Laboratory 4

BMEVIMIA315

Dr.János Hainzmann

Investigation of sensors and of signal conditioning circuits. Virtual instrumentation. Creating a data acquisition system by programmable instruments and peripherals. Use of a graphical development environment for designing test, measurement and control software. (2 credits)

Basics of Programming 1

BMEVIEEA100

Dr.András Poppe

This subject introduces the basic methods and tools of computer aided problem solving. The main goal is to provide the students with all the necessary programming knowledge and abilities that are needed during the course of their further studies. The immediate goal is to learn building of portable computer programs. These goals are achieved through the study of a powerful, general purpose, high level programming language: the C language. The practice classes follow the topics of the lectures and discuss further details of the language elements and algorithms. The main topics of the subject: First the concepts of computer aided problem solving are introduced: program, algorithm, data representation, specification, coding, documentation, testing, low level and high level programming, syntax and semantics, block diagram. Basic elements of the C language are defined: keywords, identifiers, declaration and definition. The topics of storage classes, rvalue, lvalue, main effect and side effect declarative and executable statements follow. The different data types, data structures are examined, especially the representation of numbers and logical values. Students learn how to build expressions using operators, the precedence and binding of operators and the evaluation of expressions. Expression statements, control statements and loops are explained. How to declare and

define functions, their formal and actual parameters. Next topic is global and local variables: scope of variables, the stack, lifetime of local variables, storage classes. Pointers are introduced with arrays and structures (array algorithms: linear and binary search and sort). The multiple choice statement is shown together with the finite state machine model. How does a program communicate; standard input/output, file handling. The idea of recursion is explained via well-known algorithms. Advanced topics of the semester include dynamic data handling, structures and algorithms for linked lists and binary trees and a detailed development study of a software from specification till documentation. Besides language elements and programming concepts some basic algorithms such as sorting are also introduced. (5 credits)

Basics of Programming 2

BMEVIEEA112

Dr.András Poppe

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.

The main topics of the subject:

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. (4 credits)

Software Technology

BMEVIIIA217

Dr.Zoltán László

Software engineering. Historical background. Software crisis. Concept of the technology. Software as a product. Software quality aspects. Software development process. Life cycle models. Software project planning. Riscs, Simple cost models. Scheduling. Requirement analysis and definition. Specification: functional, structural, and dynamical views. Functional description: data-flow modelling. Structural description: data dictionary, entity relationship model. Dynamical description: state transition model. Design concepts: abstraction, information hiding, cohesion, coupling. Software architectures. Object oriented software development: Object concepts. Object oriented paradigm. UML notation. Use-cases. UML structural diagrams. (Class and object diagrams). Sequence, collaboration, activity diagrams. Component and deployment diagrams. Overview on the Rational Unified Process. Component software, academic concepts: Aspest oriented programming. Verification and validation. applied techniques. Testing. Configuration management. (4 credits)

Software Methods

BMEVIAUA218

Dr.Hassan Charaf

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. (4 credits)

Operation of Information Systems

BMEVITMA314

Dr. Gábor Magyar

System-level overview and achitectures. 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 Sevices. 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. (4 credits)

Operating Systems

BMEVIMIA219

Mrs. Dr. Annamária Várkonyiné Kóczy

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. (4 credits)

Databases

BMEVISZA311

Dr. Gyula Katona

Database concepts, history, entity-relationship model/diagram, attributes, relation-types, constraints, weak entity sets. Relational database, relational algebra, extended operations, design from E/R model. Tuple relational calculus, domain relational calculus, safe expressions, completeness. Introduction to ISBL, QUEL, QBE. SQL queries: basic structure, set operations, aggregate functions, NULL values, subqueries, SQL Data Manipulation Language, SQL Data Definition Language.

Functional dependencies, logical consequence, Armstong axioms, derivation rules, key, closure, multivalued dependency, decompositions, normal forms. Transaction management: serializability, precedence graph, locks, deadlocks, 2PL, RLOCK/WLOCK, tree protocol, timestamps, logging, UNDO/REDO protocols. (5 credits)

Artifical Intelligence

BMEVIMIA313

Dr.Tadeusz Dobrowieczki

The aim of the subject:

The aim of the subject is a short, yet substantial presentation of the field of artificial intelligence. The principal presented topics are (1) expressing intelligent behavior with computational models, (2) analysis and application of the formal and heuristic methods of artificial intelligence, (3) methods and problems of practical implementations. The

subject is intended to develop the abilities and skills of the students of informatics in the area of:

- studying novel applications of the computing,
- developing effective methods to solve computational problems,
- understanding the technological and conceptual limits of the computer science,
- intellectual understanding of the central role of the algorithm in information systems.

Detailed curriculum:

Agent paradigm: Intelligent system and its environment. Formal modeling and solving of complex problems within agent paradigm. Comparing problem solving methods (search strategies). Heuristics for reducing complexity. Knowledge intensive approach and complexity. Experimenting with the scheduling problems: modeling within the paradigm and solving with the search algorithms.

Planning: Planning as a tool of problem solving. Basic representations for planning. The basics of the modern planning algorithms. Hierarchical and conditional planning. The question of the resource constraints. Integrated planning and execution. Experimenting with the assembly problems: developing plans taking into account various problems of increasing complexity.

Knowledge intensive systems. Formal representation and manipulation of knowledge. Logic based methods. Using first order logic to describe problems and to compute solutions. The functioning of rule-based systems. Inference methods for uncertain knowledge. Probabilistic inference systems. Representing vague meaning with fuzzy sets. Experimenting with the diagnostic problem with knowledge of different levels of uncertainty, using suitable methods, or experimenting with building a fuzzy system (rule-based language, fuzzy software packages, etc.).

Learning. Learning within agent paradigm. Inductive logical learning (decision trees, learning general logical expressions). Learning in neural and Bayesian networks. Reinforcement learning. Genetic algorithms and evolutionary programming. Experimenting with multiple learning problems, using suitable software packages.

(5 credits)

Software Laboratory 1

BMEVIEEA101

Dr.András Poppe

The main goal of this subject is to give the students an opportunity to try their theoretical knowledge in practice, test the algorithms on computers, develop their programming skills, which are inevitable during their future studies. The laboratory classes follow the topics of the lectures and practice classes of Basics of Programming 1. A long-term individual homework assignment helps the students reach the goal of the subject.

The main topics of the laboratory:

First the students get acquainted with the rules and facilities of the university computer centre, with the structure and the services of the university network and with the integrated environment used to build C programs. Students learn editing the source code, compiling, linking and running the program via the "Hello world" example. Number representations are examined; limits of integer and real types. The use of debugging facilities is introduced: step-by-step execution, watching variables. Students develop programs to solve second order equations, to find friendly numbers, to get the greatest common divisor and to generate elements of the Fibonacci series. Next the array handling and sorting algorithms are practised, followed by problems that can be easily solved with a finite state machine model, like /*comment*/ filter, pattern matching. Common file handling problems are covered. Recursive algorithms are tested and the stack is examined during execution. A bigger program is developed, which integrates the handling of files and linked lists. First the list handling algorithms are built; insert, search, delete. In the next laboratory the database program is completed by file handling operations. (2 credits)

Software Laboratory 2

BMEVIEEA113

Dr.András Poppe

The main goal of this subject is to give the students an opportunity to try their theoretical knowledge in practice, test the algorithms on computers, develop their programming skills, which are inevitable during their future studies. The laboratory classes follow the topics of the lectures and practice classes of Basics of Programming 2. A long-term individual homework assignment helps reach the goal of the subject.

The main topics of the laboratory:

Students first learn the non object-oriented features of C++: overloading, default arguments, using cin/cout. Then the concept of objects and classes is approached via a structure and external functions. Different classes are designed and implemented: date, stack, complex number, string etc. Dynamic array of objects and exception handling are examined. Students practice inheritance, virtual member functions, multiple inheritance. Generic classes are introduced and a complex problem is solved using C++. (2 credits)

Software Laboratory 3

BMEVIIIA212

Dr.András Poppe

This subject is an introduction to pure object-oriented programming using the Java language. The major goal is to teach how to write maintainable, reusable, and self-documenting source code in Java. First the main conception and properties of the Java programming language are introduced like the object-oriented paradigm, robustness, security, portable or platform-independent programming, Java Virtual Machine (JVM), dynamic code interpretation, and multi-threading. Afterwards, the basic elements of the Java language are discussed like the explicit and implicit type conversions, dynamic allocation of objects, converting built-in types into objects, generic arrays, strings, controlling and conditional structures, control of data access, abstract classes and methods, static attributes and methods, garbage collection, inheritance and interfaces. High-level and uniform handling of system and user-defined exceptions is explained through illustrative examples of standard input/output operations. Dynamic data structures, like multi-dimensional arrays, linked lists, binary trees are discussed in detail and the usage of the Java collection framework is illustrated. A more general introduction to object-oriented design patterns is presented taking all the case studies from the standard Java class library. Graphics user interfaces and event-controlled interaction are discussed through the Abstract Windowing Toolkit (AWT) library. Finally, the implementation of simple Java applets and game applications are explained step by step form the object-oriented design to the source code. (2 credits)

Software Laboratory 4

BMEVIIIA220

Dr.Zoltán László

This laboratory is the organic continuation of the course "Software technology". The goal is creating an object oriented application with UML (Unified Moodeling Language) description, Java implementation, due to RUP (Rational Unified Process) concepts. Students are working on the project in groups of 3 or 4. Groups formed by the consulent. Students are preparing the documentations due to the schedule given. Documentations must be handed in in pre-definite format. The project is to be realized in three steps: Skeleton, Prototype, Complete. The goal of the Skeleton version is to verify that object and dinamic models are making up the model of the task. The Skeleton is a program containing all the business objects that are going to take part in the final system. The interfaces of objects are defined only. At the beginning every method writes its name on the screen and calls the methods he needs to fulfil his service. In case calling of methods depend on condition, a question referring to the condition ought to be asked on the screen interactively so the program goes on the way the answer defines. Skeleton must also be able to help checking different scenarios and sequence diagrams. The goal of the Prototype program is to demonstrate that the program is ready, works correctly, fulfils all tasks. Prototype version is a whole program except of the detailed interface. Prototype is well planned, timing and handling of active objects is completed. All methods of the business objects contain the final algorithms - except of those concerned with appearence. Paying attention to the logic and structure of interface, to the fact how much it reflects and makes visible the functioning of the program is very important. Complete version of program may differ from prototype only becasuse of the quality of user interface. At evaluation internal structure of realization is more stressed than exteriors. (2 credits)

Software Laboratory 5

BMEVIMIA308

Mrs. Dr. Annamária Várkonyiné Kóczy

The aim of the Software Laboratory 5 is to supplement the Operating Systems course by practical knowledge in order to make the students able to efficiently handle the UNIX/LINUX operating system, to prepare simpler command files, and to use the basic programming development equipment.

UNIX operating systems basics. UNIX file system. Bourne and C shell knowledge and programming. Utilities and filters. Program development equipment, editor, make. Network basics, the Internet. X Window. Process communication. Database handling exercises. (2 credit)

Description of Economics and Human Science Subjects in Electrical and Software Engineering

Ergonomics

BMEGT52A001

Dr.Lajos Izsó, Dr.Ildikó Takács

Concept of Ergonomics: Man-machine systems, levels of functions, characteristics of the human and the technical subsystems, compatibility at different levels, significance and quality of user interface.

Stress and strain, workload and mental effort: Stress and strain (stressor and stress) in physical and mental work. Tendency for the domination of mental work: mental workload and mental effort (basic concepts, definitions, psychophysiological fundamentals. Efficiency as a function of workload (stress). ICT working tools as cognitively demanding work environment.

Working place design: Basic ergonomic principles and design guidelines for different working places: workshops in the mechanical industry, traditional and open room offices as well as other working places with VDUs, control rooms in the process industry, client service working places (governmental organizations, banks and ICT companies).

Human factors of safety: determinants of safety in high-complexity socio-technical systems (case studies from event analysis and simulator training in nuclear power plants, civil aviation and air traffic control), fundamentals of product safety (guidelines for designing safe products, statistical methods - SPC, survival analysis, neural networks, etc. - for assessing product reliability.

Human-computer interaction: The GOMS model (Goals, Operators, Methods and Selection rules), the main interaction styles (key-modal, direct manipulation and linguistic), analytical (cognitive walkthrough, guideline review and heuristic) and empirical methods of assessing usability of software and other smart products. Industrial case studies with the INTERFACE research and assessment workstation. (2 credits)

Philosophy

BMEGT41A001

The course deals with the philosophical questions of scientific inquiry. Science as an intellectual activity involves epistemological as well as methodological problems, including those of objectivity, truth, proof and refutation. Methods of explanation and prediction will be discussed, Inductive and deductive techniques of hypothesis-assessment and of constructing theories from observational data will be dealt with. Problems of scientific experimentations and quantification, the use of mathematical means in model building will come up together with their implications to the realistic interpretation of theories and scientific predictions. Questions concerning the growth of knowledge, rationality and relativism will also be discussed. Historical, sociological and institutional aspects of scientific research-work will also be touched during the course, especially with respect to the recent developments in project oriented , so called "post-academic" science. (2 credits)

Economical Politics

BMEGT33A001

(2 credits)

Information Management

BMEGT46A001

Dr. Ferenc Kiss

IT strategy - organizational goals, resources.

Informaton and knowledge base of the company.

Collection, evaluation, process, storage, sharing and usage of corporate data and information.

IT support for decision maker roles: functions, vaules, costs, DSS, EIS, MIS, ES, KBS systems.

The IT backoffice of the operation of the organization (transactional systems, data warehouse, etc.)

Internet, intranet, extranet. Groupware, GDSS.

IT project and investment.

Information management roles (e.g. information broker, data warehouse manager, knowledge engineer).

Integration of IT systems and the business strategies.

The orgranizational backgraund of management of the information management /IT systems. (2 credits)

Innovation Management

BMEGT44A001

(2 credits)

Communication

BMEGT43A001

(2 credits)

Environment Economics

BMEGT42A001

(2 credits)

Research Methodology

BMEGT41A002

(2 credits)

Vision , Language, Memory

BMEGT47A001

(2 credits)

Marketing

BMEGT33A002

Dr. Magdolna Egri, Zsuzsanna Szalkai

The role of marketing in organisations, strategic planning and marketing planning. Marketing information system and marketing research. Segmenting and targeting markets. Developing and launching new products and services. Life cycle management. Pricing strategies, selecting and managing distribution systems. Marketing communication and promotion strategies, evaluating marketing performance.
(2 credits)

Pedagogy

BMEGT51A001

(2 credits)

Money Matters

BMEGT35A001

(2 credits)

Psychology

BMEGT52A002

Dr. Lajos Izsó, Dr. Ildikó Takács

Human cognition: Sensation: sensory systems, vision, hearing, the chemical senses, somatic senses and the vestibular system. Perception: organising the perceptual world, theories and illusions. Attention, focussed and divided attention. Memory: three stages of memory: sensory, short-term and long-term. Some phenomena of memory: mnemonics, peg word system, interferences. Thinking: human information processing system. Decision making and problem solving. Mental abilities, intelligence and creativity, cognitive styles. Learning, classical and instrumental theory of conditioning. Cognitive processes in learning: insight, latent learning and cognitive maps. Social learning. Motivation: Basic concepts of motivation. Work and motivation: achievement, satisfaction and procrastination. Emotion, emotional intelligence (Goleman).Stress and coping system, some stress-coping programmes. Type A behaviour. Personality: Studying personality (tests), psychodynamic (Freud, Jung), behavioural, and phenomenological (Rogers, Maslow) approaches. The individual in the social world: Some basic sources of social influence, social perception, first impressions, group stereotypes and prejudice, attribution theory. Attitudes and persuasion. Group influences and interpersonal behaviour. Communication: assertiveness, social skills in communication. (2 credits)

Regional Economy

BMEGT42A002

(2 credits)

Accounting

BMEGT35A002

(2 credits)

Sociology

BMEGT43A002

(2 credits)

Description of M.Sc. Subjects in Electrical Engineering

Communication Engineering Specialization

Mathematics

BMETKVIM101

Mrs. Judit Győffy

Review of calculus and probability theory. Two-and multi-dimensional normal distributions (covariance matrix, marginal and conditional distributions, non-correlated and independent variables). Stochastic processes (finite dimensional distributions; realisations; mean and co-variance functions; Gaussian processes and the Wiener-process). Stationary processes (spectral representation, ergodicity). Markov chains and processes. Poisson process. (6 credits)

Physics

BMETKVIM102

Dr. László Orosz

Early stage of atomic physics. Black-body radiation. Photons. Wave-particle duality. Schrödinger's equations. Physical interpretation of the wave function. Simple solutions of Schrödinger's equation. Formal theory of quantum mechanics. Angular momentum. Magnetic moment. Spin. Pauli's principle. Fundamentals of chemical bonds. Solids. Free-electron model of a solid. Electron motion in a periodic structure. Band structure. Brillouin zones. Quantum statistics. Elements of quantum electronics. Laser and holography. Magnetic features of materials. Bases of superconductivity. Fundamentals of nuclear physics. Nuclear models and structures. (4 credits)

Signals and Systems

BMETKVIM103

László Kunsági

Basic principles and structure of communication systems. Deterministic and stochastic signals. Correlation and spectral density (PSD), stationary and ergodic processes. Frequency domain description: phasor, Fourier series, Fourier transform, spectrum, PSD. Types and characterisation of noise. Signal transmission with noise. Description of bandpass signals. Linear carrier wave (CW) modulations: DSB and SSB amplitude modulation. Modulators and transmitters. Demodulation. Phase and frequency modulation. Transmission bandwidth. PM and FM generation and detection. Interference. Preemphasis and deemphasis filtering in FM transmission. Receivers for CW modulation. (5 credits)

Radio Systems

BMETKVIM104

Dr. Mihály Szokolay, Dr. István Frigyes, Dr. Rudolf Seller

Radar: modulation methods, ambiguity diagram, target modelling, tracking methods, track-while-scan, phased arrays. Point-to-point communications: modulation methods, satellite and terrestrial architecture. Performance measures. Fading effects. Satellite broadcasting: orbits, radiation zone uplink and downlink. Community and individual Earth receivers. Receiving antennas of Earth stations. (5 credits)

Electromagnetic Fields

BMETKVIM201

Dr. Árpád Bokor

Electromagnetic field theorems: reciprocity, duality, equivalence, and the polarisation of monochromatic and quasi-monochromatic fields. Antenna characteristics. Sources of electromagnetic radiation: wire antennas, aperture antennas, analysis and synthesis of antenna arrays. Antenna engineering. Propagation of radiated electromagnetic waves: ground waves, tropospheric waves, and ionospheric waves. Propagation engineering. (6 credits)

Acoustics and Digital Signal Processing

BMETKVIM226

Dr. János Granáth, Dr. Péter Pfliegel

Mechanical elements and systems. The wave equation. plane and spherical waves. Acoustical transmission line. Acoustic elements. Acoustical capacitance, inductance and resistance. Radiation impedances. Specific impedances of plane and spherical waves. Piston and exponential horn. Transducers. Moving coil, electromagnetic and electrostatic transducers. Direct radiating and horn loudspeakers. Dynamic headphone. Dynamic and condenser microphones. Room acoustic. Noise monitoring. Sound reinforcement. Modulation schemes. AM-DSB, SSB, DSB/SC, VSB, QAM, FM. Direct and superheterodyne radio receivers. Double conversion receivers. AM and FM demodulators. FM stereo signal. Frequency and time MPX encoders and decoders. Photometry and colorimetry fundamentals. Monochrome television. Color TV fundamentals. The compatibility issue. The NTSC, PAL and SECAM systems. NTSC, PAL and SECAM encoders and decoders. Satellite television. Analog and digital systems. Encryption. Magnetic audio and video recording. Mechanical recording. (5 credits)

Telecommunication

BMETKVIM203

Dr. Gusztáv Adamis

Telecommunication services. The ISDN. Digital transmission technology. Encoding standards. Data formatting, pulse stuffing, framing, and multiplexing. PCM multiplex standards. Transmission. Protocols and protocol standards. Physical interfaces, data link control procedures, network protocols, and terminal protocols. Case studies. Future trends. Critical standards. Fibre-optic systems. Service integration. Switching exchanges and networks. Phases of call handling. SPC systems. Criteria of real-time control in telecommunications. Operating systems. Function division scheduling. Call records. Call division. Concurrent call handling. Scanning and event detection. Digit perception and number analysis. Path searching. Digital switching. Data structures in SPC switching. (5 credits)

Network Theory

BMETKVIM301

Dr. István Frigyes, Dr. László Gefferth

Discrete-time filters: finite impulse response (FIR), infinite impulse response (IIR), wave digital filters (WDF), and switched capacitor filters (SCF). Simulation, state variable analysis. Sensitivity analysis. Tolerance analysis. Optimisation algorithms: constrained and unconstrained methods. Circuit design. Distributed-parameter circuits. Wave guides for microwave and optical frequencies and scattering-matrix representation. Non-uniform transmission lines. Couplers and coupled lines. Directional couplers. Coupled-mode formalism. Distributed-parameter filters. Microwave amplifiers. Distributed parameter circuits in the time domain. Time-domain reflectometry. (7 credits)

Computer Systems

BMETKVIM302

Dr. Gusztáv Adamis

Universal microprocessor architecture. RISC architecture. Instructions, procedure calls. Register set, register windows, register optimization. RISC pipelining. Case studies. Parallel architectures, multi-processor & transputer systems; communication & access control. Multiport memory. Vector processors. Block diagram, instruction set. Case studies. Fault tolerant systems. Loosely/tightly coupled systems independent/identical processes. Tandem systems. Computer Systems, Telecommunications protocols. TCP/IP, Novell protocol demonstration. Physical and data-link layers. Ethernet, ISDN, ATM. Multiuser/multitasking operating systems, general questions. Deadlocks. Algorithms for deadlock prevention and avoidance. Process communication. Hard disk access algorithms. Case study: UNIX end X-Windows. Database management concepts. Architectures, data organization, relational queries, SQL, multi-client databases. (5 credits)

Microelectronics

BMETKVIM303

Dr. Ferenc Kovács

General problems of microelectronic integration on communication engineering. The architecture and specific details of integrated analog, digital, mixed and optoelectronic circuits used for telecommunication. Integrated optical-electrical communication systems. Typical VLSI circuits of the telecommunication, terrestial and satellite broadcasting, videotechnics and data transfer. VLSI design. Typical components of optoelectronics: waveguides, directional couplers, filters, optical amplifiers, light sources, detectors. High-speed devices of quantum-electronics. (4 credits)

Project Laboratory I-III

BMETKVIM105 BMETKVIM204 BMETKVIM304

Staff

Individual solution of complex engineering tasks that generally involve all phases of engineering research and development activities including treatment of the theoretical background and also extensive laboratory work. Typical tasks include all kinds of telecommunication devices and components of systems as well as the related computer programs, where applicable. (3+3+3 credits)

Thesis

BMETKVIM401

Staff

Diploma projects, which are generally specific engineering tasks of a higher level, are completed in the final semester. Activities carried out in the project laboratory frequently contribute to a student's diploma project. (22 credits)

Computer and Control Engineering Specialization

Mathematics

BMETKVIM101

Ms. Judit Győrffy

See description under above Review of calculus and probability theory. Two- and multi-dimensional normal distributions (covariance matrix, marginal and conditional distributions, uncorrelated and independent variables). Stochastic processes (finite dimensional distributions, realizations, mean and covariance functions, Gaussian processes, the Wiener-process). Stationary processes (spectral representation and ergodicity). Markov chains and processes. Poisson process. (6 credits)

Discrete Mathematics

BMETKVIM106

Dr. László Máté

Outline of combinatorics and mMatrix-calculus. Boolean algebras and switching circuits. Relations. Equivalence relation and partition. Recurence relation and iteration. Definition of the graph. Isomorphic graphs. Connections between the edges, vertices and degrees of a graph. (Connected) components. Testing connectedness. Strong orientation of a digraph. Conditions and algorithm.

Eulerian trail and Eulerian circuit. Search after Eulerian circuit. Algorithms. Trees. The five properties of the trees. Spanning subgraph. Spanning tree. Distance preserving spanning tree. Edge replacing algorithm. Graphs and matrices. Various representations of a graph in the computer. Planning traffic flow. Chromatic numbers. 2-colorable graph. The largest first algorithm for vertex coloring. Bipartite graph. Pairing. Minimal spanning tree (Kruskal algorithm, Prim's algorithm). The shortest path algorithm (Dijkstra). Binary tree searching algorithm. Code space. Prefix code. Huffman code. Digraph and deBrujin sequence. Languages defined by forbidden words. Digraph representation of languages. Fundamentals of Fractal Theory. Fractal representation of languages. (The Hao-Jeffrey representation). Channel code. Conditions and procedures. Data storage and coding. (5 credits)

Foundations of Computer Science

BMETKVIM205

Ms. Réka Szabó, Mrs. Judit Győrffy

Finite automata and regular languages. Pushdown automata. Representation for languages. Grammars. Recognisers. Context-free languages. Derivation rees. Transformation of ontext-free languages. Chomsky and Greibach normal forms. Turing machines and linear bound automata. Turing machines and computability. Effectiveness of algorithms. Class P and NP algorithms. Case studies with algorithms. Effective data structures. Computational complexity theory. Intractable problems. NP completeness. Parallel algorithms. Review of probability theory. Sample spaces, events, probability, conditional probability, independence. Random variables, expectation, functions of a random variable. Joint distributions, independent random variables. Markov and Chebyshev inequalities. Law of large numbers, central limit theorem. Conditional expectation. Markov chains: classification of states, stationary distributions. Poisson process. (6 credits)

Process Control

BMETKVIM109

Dr. Zoltán Benyó

The differential equation of a linear system, and its solution. Step response, and weight functions. Laplace transform. Initial and end value theorems. Transfer function. The frequency response characteristic and Nyquist diagram. The realizability of a frequency-response characteristic. The frequency response characteristic and Bode diagram. How to get the Bode diagram. How to get the Bode diagram of a compound system. Proportional, integrating and differentiating elements, and their characteristics (frequency domain: transfer function, Bode, Nyquist diagrams, time domain: step response and weight function). The basic concept of the stability. Routhand Hurwitz stability criteria. The basic concept of the stability. The Nyquist stability criteria. The critical gain of control loop and its determination. Structural stability, conditional stability. P, PI, PD, PID compensation. Multivariable control systems. Nonlinear control systems. Simulation and iden- tification of the physiological systems. (5 credits)

Digital System Design

BMETKVIM110

Dr. István Horváth

Microprocessor based design of digital systems. Computer interfacing techniques and hardware-software interface. Different approaches such as dedicated and universal systems. New concepts of 16/32-bit microprocessors. Special questions of multiprocessor-system design. Communication in multiprocessor systems, tightly and loosely coupled systems. Development tools and methods of microprocessor and multi- microprocessor systems. Computer aided design of digital systems. Automating the different steps of the design process such as system modelling, analysis and circuit design. Description of languages and simulation. Testing and self-testing, test models for LSI circuits and test generation. Design for testability. CAD and CAE tools and their application to support the design process. (5 credits)

Software Engineering

BMETKVIM212

Dr. Zoltán László

Software Engineering Concepts. Software as a product. Software life cycle. Software crisis. Software project, management concepts. People, team management. Software quality concepts. CMM, PSP models. Project planning and control. Requirement analysis, Software design, Programming language concepts. Testing, maintenance. Software life cycle revisited. Software cost estimation, quality management ccess methods and queuing models. Coding and data protection. (5 credits)

Information Processing

BMETKVIM206

Dr. György Dallos

Review of basic methods for the acquisition, transmission, and processing of information. Representations of random phenomena disturbing information. Bayes and Neuman-Pearson decision methods. Transform representation of signal and noise. Estimation, prediction, filtering, and smoothing. Adaptive and recursive procedures. Access methods and queuing models. Coding and data protection. (5 credits)

Process Instrumentation

BMETKVIM111

Dr. Károly Fock

Transducers for the physical parameters of industrial processes: electromechanical, hydro- dynamic and frequency output transducers and their static and dynamic properties. Typical signal processing. Measuring methods of industrial processes. Control engineering devices: transmitters, signal processors, controllers and control systems, actuators and final control elements. (5 credits)

Computer Aided Engineering

BMETKVIM107

Dr. Gábor Hosszú

Computer-aided engineering and electronic design. System design tools. General purpose simulation languages and hardware description language (VHDL). Computer-aided logical design. Computer-aided design of analog circuits. Modelling concepts of simulator programs, parameter identification. Scheme editors, graphic editors. Process simulation. Algorithm and model problems. Microelectronic design programs. Layout design programs. Computer support of custom design circuits. Expert systems. (5 credits)

Circuit Design

BMETKVIM112

Dr. József Zoltai

Modelling electronic circuits. Computer-aided analysis of electronic circuits (DC, AC and transient analysis). Detailed analysis of electronic circuits in the following fields: amplifiers (boosting), voltage regulators, multivibrators, sinusoidal, waveform-, ramp- and staircase-generators, voltage-to-frequency converters, voltage- and digitally controlled circuits. (5 credits)

Machine Intelligence

BMETKVIM305

Dr. György Strausz

Artificial intelligence basics for engineers. What is an intelligent system. How to solve problems with no algorithmic solution with computer systems. Rule-based system architecture. Skillful search for solution. Representing knowledge with logic and structure. Representing and handling uncertainty. Planning of actions. Machine learning. Intelligent systems and real-time problems. Model-based problem solving. Understanding natural language. Distributed intelligent systems. Hybrid intelligent systems. Case studies in applications and market products. (5 credits)

Data and Computer Networks

BMETKVIM310

Dr. József Harangozó

Signal transmission. Time domain and frequency domain representation of signals. Transmission channel. Channel characterization. Elements of the OSI architecture. The seven-layer OSI Reference Model. Functions of the physical layer. Digital transmission. Data encoding Baseband and broadband communications. Modulations. Data link layer functions. Asynchronous and synchronous protocols. Medium access conrol methods. Error detecting and correcting codes. Logical link control. Network layer functions. Naming, addressing, routing. Congestion control. Networks interconnections. Transport layer functions, services and protocols. Session layer functions. Presentation layer functions. Application layer functions, services and protocols. Network management. (5 credits)

Measuring Systems

BMETKVIM308

Dr. György Strausz

Integrating the theoretical and practical aspects of the development of large size, complex measuring systems. The first part of the course summarizes the most important aspects of the design of large size, parallel measuring sytems, and the second part of the course deals with the design and implementation of intelligent measuring systems operating in a real-time environment. Students are required to write programs that implement simple parallel, intelligent measuring model. (6 credits)

Robotics

BMETKVIM209

Dr. Béla Lantos

Basic control aspects. Parameter estimation. Time-domain design of multivariable control systems. Optimum and adaptive control. Robot classification. Robot geometry and dynamics. Path design. Local servo control. Direct control in Cartesian coordinates. Force control and compliance. Robot programming. Hierarchical control. Robot simulation. (5 credits)

Computer Systems

BMETKVIM302

Dr. Gusztáv Adamis

Universal microprocessor architecture. RISC architecture. Instructions, procedure calls. Register set, register windows, register optimization. RISC pipelining. Case studies. Parallel architectures, multi-processor & transputer systems; communication & access control. Multiport memory. Vector processors. Block diagram, instruction set. Case studies. Fault tolerant systems. Loosely/tightly coupled systems independent/identical processes. Tandem systems. Computer Systems, Telecommunications protocols. TCP/IP, Novell protocol demonstration. Physical and data-link layers. Ethernet, ISDN, ATM. Multiuser/multitasking operating systems, general questions. Deadlocks. Algorithms for deadlock prevention and avoidance. Process communication. Hard disk access algorithms. Case study: UNIX end X-Windows. Database management concepts. Architectures, data organization, relational queries, SQL, multi-client databases. (5 credits)

Project Laboratory I-III

BMETKVIM105 BMETKVIM204 BMETKVIM304

Staff

Individual solution of complex computer engineering tasks that involve designing and constructing a substantial software or hardware system under the supervision of a faculty member. Tasks generally involve all the phases of engineering research and development activities, including treatment of the theoretical background and also extensive practical work in the laboratory. Students make a final presentation on the functioning system and its supporting documentation at the end of the program. (3+3+3 credits)

Thesis

BMETKVIM402

Staff

Diploma projects, which are generally specific engineering tasks of a higher level, are completed in the final semester. Activities carried out in the project laboratory frequently contribute to a student's diploma project. (22 credits)

Power Engineering Specialization

Mathematics

BMETKVIM101

Mrs. Judit Győrffy

Review of calculus and probability theory. Two- and multi-dimensional normal distributions (covariance matrix, marginal and conditional distributions, uncorrelated and independent variables). Stochastic processes (finite dimensional distributions, realizations, mean and covariance functions, Gaussian processes, the Wiener-process). Stationary processes (spectral representation and ergodicity). (6 credits)

Network Theory

BMETKVIM117

Dr. Amália Iványi

Graph theory concepts. Application of the analysis of two-pole networks. Methods of loop-currents and cut-set voltages. Formulation of transfer quantities and functions. Formulation and solution of state equations. Multipole networks; multi-phase systems. Transmission line systems and networks. (2 credits)

Electromagnetic Fields

BMETKVIM314

Dr. Imre Sebestyén

Maxwell equations, potentials and integral representation. Static and stationary fields. Conformal mapping. Quasi-stationary fields. Eddy-currents, skin and proximity effects. Electromagnetic waves. Numerical methods: variational principles, Ritz and Galerkin procedures, finite difference, finite element and global formulation. Boundary element formulation. (3 credits)

Power Electronics

BMETKVIM216

Dr. Attila Kárpáti

New power electronic semiconductor devices and modules. Study of line commutated circuits: voltage and current characterizations of DC and AC converters. Special converter circuits. Network friendly circuits. Converter-reaction to the network. Electronic reactive-power compensation. More quadrant DC chopper. Analysis and design of forced commutated inverter circuits: single and three-phase connections, voltage regulation methods, input and output filter circuits. Application of converter circuits. (5 credits)

Thermal Systems

BMETKVIM118

Dr. László Imre

Thermal systems in electrical engineering. Theoretical basis of transport phenomena. Principles of heat transfer. Analytical and numerical methods for computation of heat conduction problems. Heat transfer by radiation. Basic principles of fluid mechanics. Laminar and turbulent flow of Newtonian fluids. Heat transfer by convection. Similarity theory. Consecutive equations. Cooling of electric machines and devices. Heat exchangers, fans and pumps. Heat pumps and cooling machines. Principles of air conditioning and climatization. Relationships between the life-time and moisture content of insulation. Principles of direct and indirect energy conversion. Conventional and nuclear power stations. (5 credits)

Electrical Machines

BMETKVIM217

Mr. Károly Németh

Transient and asymmetrical phenomena of asynchronous and synchronous machines. Space-vector and symmetrical-components methods of three phase machines. Computer simulation and calculation of rotating machines. Special types of machines: shaded-pole, split-phase, capacitor, reluctance, hysteresis and step motors. Permanent magnet DC and synchronous machines. (5 credits)

Electric Drives

BMETKVIM315

Dr. Sándor Halász, Dr. Károly Veszprémi

Dynamic characteristics of DC machines. AC/DC converter fed drives. Block diagrams in continuous and discontinuous current mode. Reversible DC drives. DC chopper drives, chopper configurations. GTO dual-converter fed DC motor drives. Park vector theory. Control modes of VSI fed induction motor drive, PWM techniques. Three-level inverters. Control modes of CSI fed drives. Control modes of converter fed synchronous motors. Microprocessor control of different drives. (8 credits)

Power System Operation and Control

BMETKVIM218

László Szabó, Dr. Andor Faludi

Requirements of electric power systems (EPS) operation. Limits of power transmission, voltage and synchronous stability. Operation of power plant's unit. Hierarchical active power - frequency and reactive power - voltage control system of EPS, reserves. High voltage direct current transmission. Electromechanical transients of synchronous machine. Excitation systems, power system stabilisers. Aim and methods of stability analysis. Hierarchy of system control, SCADA/EMS system. (5 credits)

Digital Systems

BMETKVIM119

Dr. István Horváth

Survey of 8- and 16-bit microprocessors and the important peripheral devices. Interfacing standard I/O devices and real-time processes. Serial and parallel communication and bus standards. Multimicroprocessor systems and computer networks. Design concepts for easy trouble-shooting, maintenance and high reliability. Tools of program development, debugging, trouble-shooting and maintenance. (5 credits)

Control Engineering

BMETKVIM120

Dr. Jenő Hethéssy

Computer control: computer-oriented mathematical modelling; design method for control, identification and adaptive control. Implementation of digital controllers: prefiltering, computational aspects and numerics. Plant measurements and microcomputer interface. Modes of control. Plant monitoring. Characteristics of real-time systems. Real-time operating system and concurrent programming. Process control networks. (5 credits)

Electrical Laboratory I-III

BMETKVIM121 BMETKVIM219 BMETKVIM316

Staff

The laboratory program serves to give practical background to the subjects of the Power Engineering Program. Theory is put to practice, students verify phenomena through experiments and they develop theirskill in measurements and in evaluation of results by doing. The main topics are: high voltage measurements, characteristics of electrical insulations, switching operations and transients, control circuits and characteristics, characteristics of electric machines and drives, power electronics, converter circuits, power systems and transmission lines. (3+5+5 credits)

Thesis

BMETKVIM401

Staff

Diploma projects, which are generally specific engineering tasks of a higher level, are completed in the final semester. Activities carried out in the project laboratory frequently contribute to a student's diploma project. (22 credits)

Description of M.Sc. Subjects in Software Engineering

System and Software Engineering Specialization

Concurrent and Distributed Programming

BMETKVIM125

Dr. Z. László Mr. Cs. Somogyi Mr. B. Goldschmidt

Fundamental concepts: process, thread, task, job, atomic and compound operations, deterministic- and non-deterministic execution, parallel- and concurrent programming, data- and functional parallelism. Parallel architectures: an overview for programming. Synchronisation primitives: mutual exclusion, critical region, software and hardware support, semaphore, signal. An implementation of signals in Turbo Pascal. Synchronisation in high-level languages: guarded command, monitor, channel, randezvous. Implementations in Concurrent Pascal, Occam, Ada, Java. Parallel programming in UNIX: File I/O, signal, process, pipe, FIFO, semaphore, shared memory, record locking, sockets, remote procedure call, threads. The Parallel Virtual Machine (PVM): message passing environment in UNIX. Parallel programming in Java: thread, synchronisation. Fundamentals of client-server architectures. Parallel programming of selected compute-intensive tasks. (5 credits)

Computer Graphics and Image Processing

BMETKVIM122

Dr. Balázs Csébfalvi

Creation and processing of visual information. Graphic hardware. Graphical software. Design concepts of interactive systems. Overview of handling digital images. Geometric transformation of images. Basic elements of computer vision. Geometric modeling and storing of models. 2D picture synthesis. 3D picture synthesis. Fractals. Computer animation. Typical application fields of CG and IP. Relationship between image handling and communication. (5 credits)

Data Security

BMETKVIM126

Dr. István Vajda

Need for data security (algorithmic attack). Basic notions of data security (secrecy, authenticity, privacy, integrity, non-repudiation, access control). Symmetric key encryption. Perfect secrecy. One time pad. Substitution-permutation designs. Public key encryption. RSA encryption algorithm (setup of the algorithm, basic results from number theory, prime tests). RSA security. Modes of block ciphers. Stream ciphers. Cryptographic hash functions. Crypto protocols: Party authentication (password based, challenge response). Protection of message integrity (keyed MAC, keyed hash function). Key exchange protocols. Digital signature protocols. Zero knowledge protocols. Key sharing protocols. Elements from theory of provable security. Provably secure protocols. Applications: security in Internet and mobile networks. (5 credits)

Software Techniques and Tools

BMETKVIM124

Dr. Hassan Charaf

Event-driven programing. Object-oriented programming under Windows. Document-View architecture. MFC Framework. MFC main classes: CWinApp, CFrameWnd, CDocument, CView. Message Handling using MFC. Predesigned components. Code and component reusing. Visual Studio/Visual C++. Platforms: Windows '9x, Windows NT, Windows 2000 Databases: Database access methods (ODBC, OLE DB, ADO, DAO, etc...). Data Exchange between Applications. Clipboard. DDEML/NDDEML. OLE server and container. OLE Automation. OCX/ActiveX. COM. Nework Programming: RPC (Remote Procedure Call), WinSockets, TAPI etc. (5 credits)

Object Oriented Development

BMETKVIM123

Dr. Zoltán László

Object concepts: the UML modelling, structural model (class, object diagram), behavioral model (use cases, use case diagrams, interaction diagram and statecharts), architectural model (component, deployment, collaborations, and the proper diagrams). The Rational Rose tool. Object design patterns: Observer, Mediator, Abstract factory, Factory method, Singleton, Prototype, Flyweight, Adapter, Bridge, Proxy, Facade, Composite, Decorator, State, Strategy, Template method, Visitor, Iterator, Builder, Chain of Responsibility, Command, Interpreter, Memento. The CORBA concepts. Creating client-server application using CORBA. (5 credits)

Distributed Systems

BMETKVIM220

Dr. Hassan Charaf

Techniques for reusing code, component-based development. Distributed component-based development: theoretical foundation, design. ActiveX, COM, DCOM on different platforms (NT, Win95, Solaris, Linux, etc.). Standard architectures: DCOM, CORBA. Analysis and comparison of CORBA and DCOM (efficiency, platform-independence, reliability, simplicity, scalability, etc.). JavaBean. Object Web (connection between Java and CORBA, IIOP (Internet Inter ORB protocol), ActiveX/COM). Multi-tier architectures (e.g. database applications). Transaction processing and asynchronous operation in distributed systems (MTS, MSMQ) Security issues (firewall, etc.). (5 credits)

Software Quality Control and Management

BMETKVIM221

Dr. Zoltán László, Dr. Katalin Balla

Understand what is the quality and software quality. Important Quality systems like IS0 9000 and TickIT. Measurement of the software quality: ISO9126 and other methodologies. Management techniques for predicting IT projects (COCOMO II). Techniques for improving software quality: Testing methods. Using CASE tool (Rational Rose Enterprice) for creating documentation. Methodologies for improving software projects: Capability Maturity Model. Methodologies for improving software projects personally: Personal Software Project. Trends in software development processes (Open source software development). (5 credits)

System Integration

BMETKVIM222

Dr. Imre Szeberényi, Dr. Tamás Máray

Packet switching. LAP/B, X.25/3, Frame Relay. Electronic mail - X.400. MIME. Standard and formats. LDAP, X.500. Modem, ISDN. ATM, SDH, Sonet. POSIX standard. TCP/IP architecture, protocols, applications. X-Window GUI. Web technologies (general, CGI, Servlet, CSS). Security (firewall, kerberos, IPsec, PGP, SSL). (5 credits)

Database Design

BMETKVIM225

Dr. Hassan Charaf, Mr. Ferenc Kovács

Introduction: history of database systems, their role in information technology, overview of current systems. Relational data-model: theoretical foundation, relational algebra, relational databases, tables, and views. Database design: design process, ER diagrams, data-integrity, and normalisation. SQL language: data definition statements, data manipulation statements. Joins, and aggregate functions. Physical level of databases: indices, B-tree, B+-tree. Database administration: transaction processing, optimisation of queries, database backup and restore. Distributed database systems: distributed transactions, replication, two-phase commit, distributed database models. Datawarehouse: definition, OLAP, ROLAP, MOLAP, HOLAP. Query languages and tools. Development tools. Miscellaneous database applications: data-mining, multimedia databases, digital libraries. (5 credits)

Data Presentation

BMETKVIM224

Dr. Tibor Kovács, Mr. Szilárd Péteri

Graphics and Animation techniques. Rigid body modeling. Material modeling. Use of textures. Key based animation. Motion controllers, dynamics. Real-time animation. Graphics libraries: OpenGL, DirectX. Web based systems. Web languages: HTML, DHTML, JavaScript. Cascading Style Sheets. Hot topics like XML, XSLT. Server side programming: PHP, ASP. .NET introduction. Windows Forms. (5 credits)

Embedded Systems

BMETKVIM317

Dr. Gábor Péceli

Examples of real-time systems, properties of distributed solutions. Time and order: Time measurement. Internal and external clock synchronization. Modeling real-time systems. Temporal control versus logical control. Worst-case execution time. Real-time entities and images. Fault tolerance. Real-time communication. Event triggered versus time-triggered systems. The time-triggered protocols. Information exchange with the physical environment: input/output. Real-time operating systems: task management, inter-process communication, and time management. Real-time scheduling (static versus dynamic). Validation: Formal methods, testing, fault injection, dependability analysis. System design: Requirement analysis, decomposition, design, implementation and test. Case studies. (5 credits)

Designing Web Interfaces

BMETKVIM318

Dr. Gábor Hosszú

The HTML language detailed properties and basics of the Standard Generalised Markup Language (SGML). The properties of different browsers. The role of the plug-ins. Extensions of the browser software. The dynamic HTML. Usage and development of Common Gateway Interface (CGI) programs. The language Java and the Java Virtual Machine. Introduction to the scripting languages, the JavaScript and the WMLScript. Advanced web interfaces designed by Practical Extraction and Report Language (PERL). Database connectivity by Hypertext Preprocessor (PHP) and Active Server Pages (ASP). Multimedia description web languages: Extensible Markup Language (XML), Resource Description Framework (RDF), Extensible Hypertext Markup Language (XHTML). Special web languages: Synchronised Multimedia Integration Language (SMIL), Voice eXtensible Markup Language, (VXML), Virtual Reality Markup Language (VRML). Multimedia file formats: Vosaic, StreamWorks, Internet Wave, VDOLive, QuickTime, RealMedia, Windows Media Technologies and Schockwave. The webcasting and the push technology. The content aggregators: Infogate and others. The proposed standards: Channel Definition Format (CDF), Meta Content Framework (RDF), Open software Description (OSD), HTTP Distribution and Replication Protocol (DRP) and Advanced Streaming Format (ASF). The Wireless Application Protocol (WAP), the components of the WEB protocol stack. The Wireless Markup Language, programming for the microbrowser. The future of the mobile based web communication. The WAP based casting. Building voice and video into the web. The protocol background: streaming protocols. The basics of streaming in the Internet. The Real Time Streaming Protocol (RTSP). Media servers. The web server based and the media server based streaming. Comparison of the operation of the HTTP based media stream and the RTP/RTCP based media streams. The joint operation of the RTP/RTCP and the HTTP. (5 credits)

Integrated Information Systems

BMETKVIM319

Dr. Hassan Charaf, Mr Sándor Juhász

Integrated Information System architectures. Integrated Information System definition. n-tier architecture. Application Server, Database Server, Document management and mail Server, Web Server. Heterogen Systems Data Transformation. XML. SOAP. Groupware systems. General Services. Case Studies: MS Exchange, Lotus Domino. Database Systems. Data, Storage, server architecture. Case Studies: MS SQL Server, Oracle, DB2. Server Side Components. Views, Stored Procedures, functions, triggers. Database Access. ODBC, OLE DB, ADO, JDBC. Security. Data Backup/Restore. Authentication methods. Permissions. Administration. Security levels. Database performance. Indexes. Parallel query processing. Cluster. Server parameters. Distributed database systems. Partitions, replication. Datawarehouses. Definition, Properties. Design, Filtering, Aggregations Tools: MS, Oracle, etc. OLAP. OLAP Types. Dimensions. Hierarchies. Slice-and-dice, drilling. OLAP Tools: MS OLAP, Oracle Express, Seagate Holos. Case studies. (5 credits)

Data Mining

BMETKVIM321

Dr. Ferenc Kiss

Introduction. Brief history of Data mining: the business background. Overview of the applications. Theoretical background. Frequently used Data Mining methodologies (SAS SEMMA, etc.). Accessing databases: problems with accessibility, integrity, validity. Cleaning databases. Handling missing values. Problem formulation. Sampling. Visual data analysis. Predictive modelling. Neural Networks. Decision Trees. Building score cards. Cluster Analysis. Association. Text mining. Differences among the technologies on the market. (5 credits)

Soft Computing

BMETKVIM323

Dr. János Levendovszky

Soft computing as a new paradigm for solving computationally hard problems. Basics of neural computing - the perceptron model. The Hopfield model (stability, convergence time, information theoretical capacity). Associative mapping by HN and its application to error correcting coding, pattern recognition ...etc. The Hopfield net as a combinatorial optimizer (application to routing and multi-user detection). Feed-forward neural networks (approximation capacities, learning and generalization). Application of feed-forward neural net-

work to call admission control and statistical resource management problems. Radia) Basis Functions (approximation capabilities and learning). Application of RBF networks to reliability analysis and risk analysis. (5 credits)

Project Laboratory I-III

BMETKVIM105 BMETKVIM204 BMETKVIM304

Staff

Individual solution of complex engineering tasks which generally involve all the phases of engineering research and development activities, including treatment of the theoretical background and also extensive laboratory work. The tasks generally cover the design, technology, construction, and testing of microelectronic components, devices, and circuits. Diploma projects, which are generally specific engineering tasks of a higher level, are completed in the final semester. Activities carried out in the project laboratory frequently contribute to a student's diploma project. (3+3+3 credits)

Thesis

BMETKVIM401

Staff

Diploma projects, that are generally specific engineering tasks of higher level, are completed in the final semester. Activities carried out in the project laboratory frequently contribute to a student's diploma project. (22 credits)

Description of M.Sc. Elective Subjects in Electrical Engineering and Software Engineering

Power Semiconductor Devices

BMETKVIMX04

Dr. Imre Zólomy

Power semiconductor diodes. Increasing the maximum voltage. Forward and reverse characteristics of PIN diodes. Transient processes. Power transistors. High-voltage transistors. Effects limiting high-current performance. Secondary breakdown. Transient processes in power transistors. Different power transistor structures and their technology. Fields of application. Power MOS transistors. Comparison of MOS-bipolar performance. Design process of power MOSFETs. Transient processes. Thyristors. Static characteristics. Construction and design of thyristors. The dV/dt and dI/dt problems and their solution. Triacs. High-power integrated circuits. (4 credits)

Semiconductor Memories

BMETKVIMX05

Dr. Imre Zólomy

Survey of semiconductor memories and their development trends. Random access memories (RAMs). Dynamic RAMs. Structures of memory cells, sensing amplifiers, and periphery circuits. Architecture of RAM chips. Problem of soft errors. Application of redundancy. Static RAMs. Basic cells, sensing and periphery circuits. Bipolar RAMs. Read only memories (ROMs). Mask programmable ROM. Field programmable ROM (PROM). Erasable PROM (EPROM). Special floating gate MOSFET of the EPROMs. Electrically erasable EPROM (EEPROM). Application of tunnel effect in EEPROMs. Flash-EPROM as a good compromise. Charge-coupled device (CCD) as memory and as an image-sensing element. Special memory devices. (4 credits)

Device Physics of VLSI and ULSI Integrated Circuits

BMETKVIMX06

Dr. Imre Zólomy

Trend toward decreasing dimensions in integrated circuits. Rules of scaling. Survey of technologies for small device dimensions. New bipolar structures. Polysilicon-emitter, tunnel- emitter, and hetero-emitter bipolar transistors. Reducing the size of MOSFETs. Short-channel and narrow-channel effects. Consequences and limits of reducing the thickness of the gate oxide. Problem of hot electrons. Quantum mechanical effects in the inversion layer of the channel. Parasitic bipolar effects. Problem of latch-up in CMOS circuits. Devices in ultrahigh-speed ICs, MESFETs and HEMTs. (4 credits)

Advanced Computers and Parallel Architectures

BMETKVIMX08

Dr. István Erényi

Introduction of parallel computing: classification of modern computer systems, basic components and functional elements, general and special purpose architecture. Application, implementation, and design of parallel computer systems. Hardware implementations. Adaptive parallel processing systems. Discussions cover multitransputers, multi-microprocessors, hypercubes, processor and systolic arrays. (4 credits)

Simulation

BMETKVIMX09

Dr. András Jávor

Methodology of model building and simulation. Survey of mathematical and software tools. Trajectory description in the state-time space. Petri nets. Artificial intelligence in simulation. Process identification and optimization. Compartment models for physiological systems. Event recognition methods. Applications of simulation (physical and physiological systems, management and manufacturing, and informatics). (4 credits)

Biomedical Instruments

BMETKVIMX10

Dr. Ákos Jobbágy

Overview of the human body: the heart and circulatory systems, respiratory and nervous systems. Theory of operation and basic building blocks of electrocardiographs, physiological pressure measuring instruments, respiratory instrumentation, intensive care units, instrumentation for measuring brain parameters, and medical laboratory instrumentation. Safety problems in the medical environment; computer applications in biomedical instruments. (4 credits)

Biomedical Engineering

BMETKVIMX11

Dr. Zoltán Benyó

Computer analysis of physiological processes. Multicompartment models. System identification and event

recognition. Computational statistics and its application to the investigation of tumors of the digestive system. (4 credits)

Robot Control

BMETKVIMX13

Dr. Béla Lantos

Basic ideas such as controlled mechanisms, path, task, PTP and CP controls, and homo- geneous transformations. Robot models, direct and inverse problems, and path design. Control of free motions: decentralized joint control, computed torque, sliding control, RMAC, and nonlinear decoupling. Hybrid position and force control. Model reference and self-tuning adaptive control. Real-time implementation. Robot programming. Knowledge-based and fuzzy control. (4 credits)

Advanced Computer Networks

BMETKVIMX14

Dr. Gyula Csopaki, Mr. Csaba Simon

ATM Networks: ATM Reference Model, Cell Format. Virtual Paths and Virtual Circuits. ATM Adaptation Layers, ATM Service Classes. ATM Traffic Management, Routing. ATM Signalling, UNI 3.x, UNI 4.0, PNNI. Making a Phone Call over ATM. SONET/SDH, Frame Relay, ATM over SONET/SDH. IP based Networks: Circuit Switched vs. Packet Switched Networks. IP, ISO/OSI Reference Model, TCP, UDP, ICMP. Repeaters, Bridges, Routers. ARP, BOOTP. Routing: Distance Vector, Link State. RIP, OSPF. OMP, Multicast issues. IP over ATM. Mapping packet switched networks into circuit switched ones. LANE, employees. (4 credits)

Thyristor AC Drives

BMETKVIMX15

Dr. Attila Kárpáti

DC link converters. Voltage source inverters and the six-step inverter circuit. Pulse-width modulation (PWM). Current source inverters, Park vector loci and rating of the inverter circuit. Converter-controlled synchronous motor. Most common control strategies for inverter fed AC motors. Servo drives. Subsynchronous static converter cascade. (4 credits)

Lightning Protection

BMETKVIMX18

Dr. István Berta

General review of lightning phenomena and the characteristics of lightning. Principles of lightning protection for structures. Calculating the probability lightning strikes. Interception efficiency of air terminal systems. Applying model experiments and computer programs to determine possible failures of the protection. Effects of the lightning current. Evaluating the risk of damage. Practical solutions for lightning protection of high-voltage lines or stations, buildings, and other structures. (4 credits)

Electromagnetic Compatibility

BMETKVIMX19

Dr. István Berta

Electromagnetic influence; conductive, inductive, and capacitive effects. Electromagnetic pulses, lightning protection, estimation of risk, secondary effects, nuclear electromagnetic pulses. Electrostatic discharges, accumulation and dissipation of charges, static elimination and control, measurement of electrostatic fields. Radio frequency influence, grounding, shielding, and coupling. (4 credits)

Computer-Aided Design of Electrical Machines

BMETKVIMX20

Dr. István Vajda, Mr. Károly Németh

Construction and design of transformers. Specific loading. Magnetizing current and core loss, leakage impedance and load loss. Temperature rise. Surge voltage distribution. AC armature, DC field windings. Choice of winding. Main dimensions of AC and DC machines. Magnetic circuits in induction and synchronous machines. Core losses. Design of single-cage and double-cage rotors. Skin effect. Effects of harmonics. Calculating main field and leakage field reactance. Design of inter- poles and compensating windings. Ease of computer design and optimization. (4 credits)

Special and Micro-machines

BMETKVIMX21

Dr. István Vajda

Single-phase and split-phase induction motors. Capacitor motor. Shaded pole motor. Self-excited induction generators. Reluctance motor. Hysteresis motor. Permanent-magnet synchronous and DC motors. Brushless DC motors with electronic commutators. Series commutator motors for AC supply. Linear induction motor for low-speed and high-speed applications. DC and AC servo motors. Synchro systems. DC and AC tachometers. Variable reluctance and permanent-magnet stepping motors. (4 credits)

Measurement of Electrical Machines

BMETKVIMX22

Dr. Károly Veszprémi

Measurement of transformers; no-load, load, and short circuit tests. Measurement of zero sequence flux and resulting additional losses. Measurement of asynchronous machines; no-load and load additional losses. Synchronous machines; transients and torque angle. Measurement of DC motors. Characteristics of different types of machines. Measurement of losses. (4 credits)

Optical Communication

BMETKVIMX24

Dr. Gyula Veszeli, Mr.Sándor Takács

Lightwave fundamentals. Optical fiber wave-guides: modes, attenuation, dispersion. Optical fiber cables. Light sources: LEDs and laser diodes. Light detectors: PIN and avalanche photodiode. Couplers and connectors. Modulation. Noise and detection, receiver circuits. System design, analog and digital. (4 credits)

Numerical Electromagnetic Field Analysis

BMETKVIMX27

Dr. Imre Sebestyén

Maxwell's equations, introduction of potentials, integral and differential formulations. Numerical methods in solution of problems: concept of finite differences, finite elements and integral equations. Computer realisations of numerical methods, solvers, pre- and post- processing. Finite element program systems and applications for high voltage problems, electrical machines, waveguides and antennas. (4 credits)

Radio Measuring Systems

BMETKVIMX28

Dr. István Frigyes, Dr. Éva Gödör

Introduction and radar equation. Detection theory. Radar targets. Antennas. Waveforms and signal processing. ECM. Search and tracking radars. Secondary surveillance radars.

Radio navigation systems. Two-way systems: VOR, DME. Hyperbolic Systems: LORAN, OMEGA, DECCA. Pseudoranging Systems: GPS, GLONASS. Radio astronomy: antennas, interferometers. Radiometer receivers. Dicke radiometer. Radar astronomy. Remote sensing: scatterometer, imaging radars airborn and spaceborn. ERS-1 experiences. (4 credits)

Radiowave Propagation and Digital Communications

BMETKVIMX29

Dr. István Frigyes

Digital transmission - generalities; digital radio applications (land mobile, satellite mobile, trunk and short-haul terrestrial, indoor, etc.) Summary of the characteristics of digital transmission: noise, linear and non-linear distortion effects. Multiple access channels and methods of multiple access. Phenomenological characterization of the radio propagation medium (land mobile, satellite personal, wide-band fixed terrestrial, mm-wave, etc.). Characterization of flat fading in fixed terrestrial communications - multipath and precipitation induced; fading countermeasures in the lower and higher microwave bands as well as in the mm-wave bands. Selective fading in fixed terrestrial microwave transmission; countermeasures to selective fading; diversity systems. General characterization of time variant linear channels. Application to the wide-band and time variant characterization of mobile and indoor channels. Multipath countermeasures in general channels; diversity methods; special methods - Rake detection etc.; A case study: the satellite-to-indoor channel; polarized vs. diffuse characteristics; special properties of Doppler. Special problems in antenna design for fixed and mobile terminals. Adaptive equalization in fixed and mobile communications. (2 credits)

Video and Sound Systems

BMETKVIMX30

Dr. János Granát, Dr. Péter Pfliegel

Photometry and Colorimetry Fundamentals. The Human Eye and Vision. Monochrome and Colour Tv Standards. Magnetic and Laser Video Recording. The Human Ear and Hearing. Acoustical Fundamentals. Electroacoustical Devices. Radio Receivers. Magnetic and CD Audio Recording. Electroacoustical Measurements. Digital Audio Signal Processors. (4 credits)

Basics and Application of Technical Acoustics

BMETKVIMX31

Dr. János Granát, Dr. Fülöp Augusztinovicz

Sound and sound fields: The phenomenon of sound in fluids; basic acoustic quantities; governing equations; the wave equation and its solution; acoustic power, intensity and impedance; examples of idealised sound fields. Demonstration: visualisation of various sound fields. Sound propagation on one-dimensional acoustic systems: Notion of concentrated parameter acoustic elements; acoustic mass, complience and and resistance; theoretical and matrix description of one-dimensional systems (wave-guides); notion and calculation of acoustic transfer functions. Practice: acoustic description and calculation of the sound attenuation of a simple automotive exhaust system. Sound in three-dimensional enclosures: Eigen-modes of closed acoustic spaces; modal description of 1, 2 and 3-dimensional systems; acoustics of small and large enclosures (wave theory vs. geometrical description). Demonstration: eigenmode calculations of simple, regular acoustic spaces. Basics of fluid-structure interactions: Interactions between mechanical and acoustical elements: radiation, vibration response, sound absorption and transmission; radiation from vibrating surfaces. Demonstration: radiation from an infinite vibrating plate for various parameter-combinations. Basics of numerical acoustical calculations: Finite Element Method: derivation of matrix description on the basis of the variational principle; eigenmode solutions and forced acoustic response. Boundary Element Method: derivation of the BE equation; solution procedures; comparison with the FE method. Practice: computer calculations of eigenmodes of a car cavity. Acoustic measurements: Measurement of basic acoustic quantities; construction and application of the sound level meter; methods of frequency analysis. Practice: sound level and spectrum analysis of a simple mechanical noise source (electric drill). Principles of noise control: Causes and operating mechanisms of typical noise sources; principles of noise control; practical application of sound absorbing and sound insulating structures. Demonstration: case studies of failed and successful noise control solutions. (4 credits)

Queuing Systems

BMETKVIMX32

Dr. László Jereb, Dr. Miklós Telek

Introduction. Motivations of queuing theory. Basic notation (arrival and departure processes, performance parameters). Little's result. Summary of probability theory. Discrete and continuous time Markov chains. Random walks. Birth-death processes. Poisson process. Stability of Markov chains. Equilibrium solutions. Holding time. Application of z-transforms and Laplace-transforms for generating transient solutions. Elementary queuing theory. Kendall's notation of queuing systems. Basic queuing systems. M/M/1 queue. Loss and waiting (M/M/m, M/M/m/m) sytems. State dependent arrivals (M/M/1//N queue). Comparison of performance parameters (state probability distribution, channel utilization, waiting time). Queuing networks. Product form solutions for open and closed networks. Application of queuing models for multiuser communications. Performance modelling and analysis of communication networks (circuit and packet switching), computer architectures, polling systems, random access (ALOHA, CSMA), ATM. (4 credits)

High-Level Logic Synthesis

BMETKVIMX33

Dr. Péter Arató

Basic concepts and goals of the behavioural synthesis of special purpose high-speed systems. Dataflow and control flow descriptions. Increasing the throughput by pipelining. Design methods for a given pipeline restarting period. Handling of conditional branches and recursive loops. Buffer insertion and applying multiple operations for reducing the restarting period. ASAP and ALAP sheduling, list scheduling, force-directed scheduling, applying integer linear programming. Allocation by covering non-concurrent operation and topological cover of operations. Synchronization and control principles. Examples for comparison and benchmarks in digital signal processing (FIR filter, elliptical wave filter, expansion of determinant, differential equation solver. etc.). A CAD tool for application specific design using VHDL. High-level synthesis applications in hardware-software codesign. (4 credits)

Microprogrammed Logic Circuit Design

BMETKVIMX34

Dr. Ferenc Kovács

Architecture and main units of micro- controllers, special peripheral circuits for timing, data communication, analogue signal handling and data security. The use of special instructions. Tools for program development and download. Architecture and program storage of reconfigurable logic cir-

cuits. Advanced types of field programmable gate arrays (FPGA) and programmed logic devices (EPLD, EEPLD). Design of programmed logic circuits using high-level circuit description language. Typical applications of microprogrammed logic circuits on the field of signal processing, data communication, measurement instrumentation and automation. (4 credits)

Advanced Soft Computing

BMETKVIMX36

Dr. Annamária Várkonyi-Kóczy

Measurement and modelling. Intelligent measurement systems. Modelling problems. Architectures. The role of AI. The idea of "imprecise computation". Theoretical limits. Treatment of the qualitative knowledge. Consequences. Real-life environment. Finite resources and changing load. Precise computations within a gradually degradating framework. Imprecision from complexity. Computation without algorithms with neural networks. Algorithmic computation with relaxed mathematical backgrouns. Fuzzy logic and application. Evolutionary computational models. Hybrid architectures. Embedding FL, NN & GA in symbolic AI architectures. Matching tools to problems. How to choose them purposefully. Case studies. (4 credits)

Pulse Width Modulation (PWM) in Electrical Drives and Power Supplies

BMETKVIMX37

Dr. Sándor Halász

Carrier-based PWM techniques (sinusoidal modulation with and without zero order harmonic injection in reference ware, natural and regular sampling). Optimised PWM technique (loss-minimised and harmonic elimination PWM). The point current or flux control simple-phase and three-phase inverter PWM control methods. Two and three level inverter PWM techniques. Generalized quality index of drives supplied from PWM inverter. (4 credits)

Microcomputer Controlled Electrical Drives

BMETKVIMX38

Dr. Károly Veszprémi

Hardware elements: CPU (processors, controllers, DSPs), signal sensing, firing control, PWM techniques. Software elements: sampling, nonlinear functions, control algorithms, filters, software scedules. Examples: Adaptive control of a DC drive, Field oriented control of induction motor drives, Converter controlled synchronous drive, servo drives. New tools and trends in motion control (fuzzy logic, neural networks). (4 credits)

Non-Conventional Energy Converters

BMETKVIMX39

Dr. István Vajda

Principles of direct energy conversion: Direct and indirect energy conversion. Problems of efficiency and reliability. Demand for electrical energy. Utilization of renewable energy sources. Fuel cells: Historical background. Physical and chemical processes in fuel cells. Efficiency of fuel cells. Technology of fuel cells. Application of fuel cells. Solar cells: Historical background. The photovoltaic effect. Characteristics of the radiation of the Sun. Calculation of the electric characteristics of solar cells. Design and technology of solar cells. Application of solar cells. Thermogenerators: Historical background. The thermoelectric effects. Calculation of the electric characteristics of thermogenerators. Design and technology of thermogenerators. Application of thermogenerators. Heat pumps: Historical background. Thermodynamics of heat pumps. Calculation of the operational charateristics of heat pumps. (4 credits)

Physical Principles and Engineering Applications of Superconductors

BMETKVIMX40

Dr. István Vajda

Principles of superconductivity: History of superconductivity. Phenomena of superconductivity. Macroscopic and microscopic theories of superconductivity. Low- and high temperature superconductors: Types of super- conductors. Characterization of superconductors. Possibility of room temperature superconduc- tivity. Competitiveness of superconductors over conventional materials. Superconducting materials: Superconducting parts and components; wires and conductors. Technology of superconductors. Availability of superconductors in the world market. Modelling of superconductors: Static and dynamic behaviour of superconductors. The critical state model. Pinning, flux creep, flux flow. Magnetization, hysteresis and ac losses. Review of the existing models. Case studies on superconducting devices. Industrial applications of superconductivity: Power engineering applications. Medical, microelectronic and measurement applications. Future of the application of superconductors. (4 credits)

Control Systems Engineering I-II

BMETKVIMX41 BMETKVIMX42

Dr. Zoltán Benyó

Linear Systems Theory. Laplace transformation. Linear systems stability. Frequency response analysis. Root locus theory. Classical compensation. Discrete systems. State variable approach. Non-linear Systems. Linearization of non-linear systems. Phase plane analysis and classification of linear systems. Non-linear system stability. Approximate methods for non-linear oscillations. Bilinear systems. Optimal control theory. Classical optimisation theory. Classical calculus of variations. The Pontryagin maximum principle. Dynamic programming. The linear regulator and generalisations. Stochastic systems. Discrete estimation and filtering. Continuous estimation and filtering. Linear stochastic control. Non-linear estimation. Computational aspects of linear filtering. System identification. Adaptive Control, Self-tuning Control and Variable- structure Systems. Adaptive control. Self-tuning control. Variable-structure systems. Multivariable Control Systems (MCS). Description of MCS. Stability of MCS. Compensation of MCS. Compartmental analysis in biology and medicine. The analytic theory of linear com-partmental systems. Non-linear compartmental systems and radioactive tracers. Partly compartmental and flow system. Evaluation of measurement data from clearance tests. Computerised simulation. Physiological System Identification. Parameter assessment. Event recognition methods for determining the illnesses of the physiological systems. Application of computational statistic to the investigation of tumours of the digestive system. (4+4 credits)

Advanced Control Theory and Design

BMETKVIMX43

Dr. Béla Lantos

This lecture gives an overview of the most important new theoretical and design methods of control engineering especially for multi- variable systems. The main topics are: Computer controlled system design, Multi-variable control based on state spece methods, Nonlinear and optimal control systems, System identification, Adaptive control, Fuzzy, neural and genetic algorithms, Control systems design using soft computing methods. (4 credits)

Industrial Instrumentation Fundamentals

BMETKVIMX45

Dr. Károly Fock

Instrumentation systems, transducer fundamentals. Instrumentation in the process industry* pressure, liquid and gas flow, liquid-level, temperature measurements and their transducers, gas analysis, industrial measurements with radioisotopes, humidity, specific-gravity and viscosity measurements, pH-measurements. (4 credits)

Power System Protection

BMETKVIMX46

Dr. György Varjú, Dr. Kornél Petri

Detection of faults, protective relays, current and voltage transformers. Protection of transmission and distribution lines; overcurrent and distance protection, pilot protection. Rotating machinery protection; possible faults, different kinds of protective relays. Transformer protection; differential protection, Buchholz relays. Future trends in power system protection. (4 credits)

Multichip Modules

BMETKVIMX50

Dr. Zsolt Illyefalvi Vitéz

This optional subject provides the expertise required for the design, manufacturing, assembly and testing of Multichip Modules (MCMs), the most modern electronics inter-connection and packaging technology. The discussion of the three types of MCMs: Laminated, Ceramic and Deposited based Multichip Modules (MCM-L, MCM-C and MCM-D). The main topics are as follows: materials; design and layout; fabrication of the interconnect substrate; thermal management; assembly methods; inspection and electrical testing; failure modes and mechanisms; com-parison with other packaging approaches; characteristics and commercial/consumer applications of MCMs. (4 credits)

Sensor Technologies and Applications

BMETKVIMX51

Dr. Gábor Harsányi

Basic terms and definitions, requirements, market trends, current research directions, microelectro- nics sensor technologies: silicon processing and micromachining, ceramics, thin and thick films, compatible polymer deposition processes; sensing effects: thermoresistive, thermoelectric, photoconductive, photovoltaic, piezoresistive, piezoelectric, pyroelectric, magnetoresistive and Hall-effects, adsorption and absorption of chemical compounds, basic chemical sensor structures (impedance, FET, resonator, calori- metric, fibre optic and electrochemical cell types), "biosensing" reactions; temperature sensors: thermoelements, resistance thermometers, silicon based sensors, integrated versions; the application of temperature sensors for the measurement of other parameters: bolometers, thermopiles, flow meters, heat flow sensors; mechanical sensors: force, pressure, acceleration, angular movement, flowrate, position, acoustic, etc. sensors, tactile sensors in the robotics; non-mechanical physical sensors: magnetic field, heat flow, radiation, optical sensors, chemical sensors for humidity (ceramic, electrolyte, semiconductor based types, dew point sensors) and gas sensors (semiconductive oxide, electrolyte and polymer based types), ion- selective sensors (electrodes, ISFETs); polymers in chemical sensors (selective sorbents and permselective membranes, composites with ion-carriers, dyes or conductive particles, polymer interfaces and matrices for intelligent chemical receptors: the application of cage compounds and poly-siloxanes, electroconductive conjugated polymers); application in the environment protection, comfort and safety; special sensors for the automotive electronics, sensors for biology and medicine: sensors for inorganic compounds in blood and tissues, enzyme-based biosensors for glucose, urea, etc., immunosensors; multi- sensors, multifunctional sensors, sensor arrays, smart sensors; signal processing and transmission, system architecture, neural networks and pattern recognition in sensor systems. (2 credits)

Digital Signal Processing Solutions

BMETKVIMX53

Dr. Péter Pfliegel, Dr. Fülöp Augusztnovicz

Filter design support. ASPI's digital filter design package. Procesor-independent DSP simulators. Alkin's PC-DSP, Burr-Brown's DSPlay. Detailed description of TMS320C5x DSP family. HW architecture and environment. On-chip memory management. On-chip peripherials. External memory interfacing. I/O devices. TMS320 DSP SW environment. The COFF concept. Assembler, linker and simulator. C5x instruction set. SW development kits and boards. TMS320C50 DSK, TMS320C50 Evaluation Module. TMS320C80 Software Development Board. (4 credits)

High Power Switching

BMETKVIMX54

Dr. István Berta, Mr. István Kiss

Review of power system layout and represen- tation. review of short circuits and faults in power systems. General requirements of interrupting devices. Electric arc formation, consideration of thermal and dielectric characteristics, mechanism of arc extinction. A.c. and d.c interruption. Low voltage switchgears, equipment parameters and classification. Solid state devices. High voltage switchgear, switching duties and breaking capacity, ratings of switching devices. Application of switchgears. Switching operations and transients, inrush currents and transient recovery voltages. (4 credits)

High Voltage Engineering

BMETKVIMX55

Dr. István Berta, Dr. Norbert Szedenik

Electric field calculation of practical insulations. Physical processes in dielectrics due to electric field: conduction, polarization and breakdown, effect of physical parameters. Gas discharges, breakdown, and electric arc. Fundamentals of lightning, and lightning protection. Breakdown of insulating liquids. Electric and thermo-electric breakdown of solid dielectrics. Surface phenomena. Electrostatics. High potential testing of insulations. Generation and measurement of high a.c., d.c. and impulse test voltages. Test methods and evaluation of test results. (4 credits)

Internet New Generation

BMETKVIMX56

Dr. Gyula Csopaki, Mr. Csaba Simon

Introduction to QoS: QoS Objectives. QoS Parameters. QoS in ATM, Effective Bandwidth. QoS IP: Main Drawbacks of Packet Switched Networks. Overview of QoS architectures for IP. IntServ Concept. DiffServ Concept. MPLS over IP. QoS Routing in IP. Mobility and Security in IP: Service Location Protocol. Mobile Agent Discovery. Route Optimization. Ad-Hoc Networking. IPSEC, FreeS/WAN. IPv6: Motivation. IPv6 and IPv4 internetworking issues. Multicast. QoS. Mobility. (4 credits)

Application of Internet Databases in Circuit Design

BMETKVIMX59

Dr. Gábor Hosszú

Computer-aided design systems (e.g. VHDL), especially the design tools of the microprog- ramming circuits. Circuit design and synthesis based on hardware description language. The most popular microprogramming circuit. The basics of the Internet based communication. Theoretical questions of the datatransport through the World Wide Web. Usage of the remote databases in digital system development. The questions of the remote access of the CAD systems developed in the Department of Electron Devices, BME. The conditions of the portable circuit designs. Implementation of digital system designs into different technological environments. Methods of creating designer information centre. Software guard methods again breaking through the network. (4 credits)

Production Informatics

BMETKVIMX60

Dr. Béla Szikora

Modelling of factories and their basic information processes. Functional moduls and their integration by the philosophy of the computer integrated manufacturing. Production planning and scheduling (PPS) systems. Data models of the enterprises including products and technologies. The continuous information flow through the functions. (4 credits)

VHDL Application in Circuit Design

BMETKVIMX61

Dr. Gábor Hosszú

Overview of computer-aided design systems. The design tools of the microprogramming circuits. Basic language structures of the VHDL development and modelling language. Circuit design and synthesis based on hardware description language. Some popular microprogramming circuits. Theoretical questions of the datatransport through IP compatible interfaces. Usage of the remote databases in digital systems development. The remote access of the CAD systems. Some special design problems of portable circuits. Implementation of digital systems designs into different technological environments. (4 credits)

Public Wireless Networks

BMETKVIMX63

Dr. Gyula Csopaki, Mr. Csaba Simon

Propagation models: Reflection, Diffraction, Scattering. Outdoor vs. Indoor propagation. Problems in Mobile Radio Propagation. Multipath propagation, Fading. Modulation Techniques: Amplitude, Angle, Digital Modulation. Linear Modulation. BPSK, DPSK, QPSK, ?/4 QPSK. Constant Envelope Modulation. Spread Spectrum Modulation. Equalization, Channel Coding: Equalizers in Communication Receivers. Linear -, Nonlinear-, Adaptive Equalizers. Diversity Techniques. Channel Coding. Block- , Convolutional Coders, Coding Gain. Multiple Access Techniques for Wireless Connections: Frequency Division Multiple Access. Time Division Multiple Access. Spread Spectrum Multiple Access. Space Division Multiple Access. Packet Radio. (4 credits)

Active Networks

BMETKVIMX64

Dr. Gyula Csopaki, Mr. Csaba Simon

Introduction of the programmability concept. Problems with the classical networks. Concept of programmability. General overview of active networks architectures. Application of active networks. Application of active techniques in computer networks. Active multicast. Code caching. Active congestion control. Multimedia applications. Network management. Programmable & Active network architectures Criteria for establishing a practical active network. Active packets approach: Characteristics. Overview of the existing architectures. Active nodes approach: Characteristics. Overview of the existing architectures. Active packets and nodes approach: Characteristics. Overview of the existing architectures. Security in Active networks: Security problems in active networks. Overview of the existing security proposals. Analysis of the security's impact on the network's performance. (4 credits)

Media Communication

BMETKVIMX65

Dr. Gábor Hosszú

Traditional and streaming media formats. Protocols for the audio and video transmission. Real time properties of the Internet. Protocol background of the media communication on the Internet. The unicast, the multicast, the multipoint multicast, the concast and the broadcast methods. The different types of the group management protocols. Multicast routing. The hyperspace of the multicast transport protocol parameters. The components of the reliable multicast transport protocols. The implementations of the different types of reliable multicast communication. QoS considerations in the media communication. Whiteboard and shared works space systems. Session directory tools. (4 credits)

Numerical Methods I-II

BMETKVIMX52 BMETKVIMX57

Dr. Ilona Arany

Introduction to the MATLAB. Solving nonlinear equations (Newton's method, Method of tangential parabolas, Interval halving method). Solving systems of nonlinear equations (Newton's method, Continuation method). Matrix eigenvalue problem (Power method, QR-method). Direct methods for solving systems of linear equations (Gaussian elimination, Gauss-Jordan's method, LU-factorization). Iterative refinement. Iterative methods for solving systems of linear equations (Jacobi's method, Gauss-Seidel's method); convergence analysis. Determining the inverse of a matrix (Gauss-Jordan's method, LU-factorization). Determining the inverse of a partitioned matrix. Determining the value of determinant of a matrix. Interpolation (Lagrange, Hermite, spline). Least square method. Numerical derivation and numerical integration. Solving systems of linear equations with positive definite symmetric coefficient matrices. Cholesky factorization. Eigenvalue problem, similarity transformation, spectral condition number. Quadratic functionals and its minimization. Gradient method and its convergence. Preconditioning. Finite difference method for solving some problems of partial differential equations (Dirichlet problem, heat convection problem, Neumann problem, considered for 1D and 2D). Algorithms for solving systems of linear equations with tridiagonal/block-tridiagonal coefficient matrices. Ordering algorithms for sparse symmetric matrices. Red-black ordering. Solving the relevant transformed system of linear equations. (4+4 credits)

Data Protection and Freedom of Information

BMETKVIMX66

Dr. Iván Székely

Theoretical basis. The borderlines of openness and secrecy in society, politics and business. Basic information models of the relationship between the public and private spheres. Cultural differences, national and regional traditions. The findings of empirical research. Historical overview. The evo-

lutionary model of access to public information. The interrelationship of technological and social development. The Western and Hungarian/East-European model. Political and politological aspects. Hierarchical and network models of information flow. The Party-state's information monopoly. Orwell or Athens: totalitarian surveillance or direct democracy? Informational liberties, online and offline movements, civil organizations. The basic principles of data protection. Information self-determination and its limitations. Models and types of data protection legislation and regulation. Examples of developed countries. The Hungarian data protection legislation. International norms, transborder data flow. Data protection institutions, functions and expertise. The independent supervisor, the internal trustee, the data protection consultant. The role and power of the Data Protection Commissioner, experience of his activity. Organizational and management tasks at the companies' level. Privacy policies in business organizations. The practice of handling personal data, sectoral characteristics. List-brokering, direct marketing. Abuse of personal data. The interrelation of informational self-determination, freedom of information and the right to scientific research. New possibilities and limitations of access to data of public interest. Meta-data, information locator systems. Data quality, objectivity - or propaganda on the internet? Privacy Enhancing Technologies (PET). Types and classifications of PETs. The theory and application of authentication without identification; digital pseudonyms, bioscrypt, anonymous remailers, digital cash. (4 credits)

Design of Power Electronic Circuits

BMETKVIMX97

Dr. Attila Kárpáti

Electric Utility Applications: High-Voltage dc Transmission, Static var. Compensators, Interconnection of Renewable Energy Sources and Energy Storage Systems to the Utility Grid, Active Filters. Optimizing the Utility Interface with Power Electronic Systems: Generation of Current Harmonics, Power Factor, Harmonics Standards and Recommended Practices, Electromagnetic Interference. Practical Converter Design Considerations: Snubber Circuits, Gate and Base Drive Circuits, Component Temperature Control and Heatsinks, Design of Magnetic Components. (4 credits)

Control of Power Electronic Converters

BMETKVIMX62

Dr. Attila Kárpáti

Static characteristic of the power semiconductors, (short overview). Gate and base drive circuits, (Design considerations, dc-coupled drive circuits, electrically isolated drive circuits, cascade connected drive circuits, thyristor, transistor, FET, IGBT, drive circuits, drive circuits for intelligent power moduls, power device protection in drive circuits). The converter as a part of the control circuit, (theoretical models for the ac/dc, ac/ac, dc/dc and dc/ac converters). Short summary of the applied control theory, (calculation of the steady state and the transient behaviour. Calculation of the optimal controller parameters). Practical design of the most frequently used control circuits used in the power electronics, using the MATLAB. (4 credits)

Power Generation by Solar Cells

BMETKVIMX72

Dr. Attila Kárpáti

Theory of the pn-junction. Operation and Characteristic of the typical semiconductor elements of the power electronics, (Diode, BPT, FET, IGBT, Thyristor). Operation and Characteristics of the typical solar cells. Examination of the operation of some typical types of the power electronics circuits, by using the electronic circuit simulator PSPICE. Operation of the various type of converters for the utilization of the electrical energy generated by solar cells, (autonomous and not autonomous electrical systems). Investagation of various solar cell systems. Rules of the locating. Cost calculations. (4 credits)

C++ Programming

BMETKVIMX76

Dr. Hassan Charaf Mr. Sándor Juhász

Overview of the C language. Object oriented programming with C++ language: reference types macros, inline functions, polymorphism, abstract classes, operator overloading, exceptions, namespaces, parameterized types (templates), standard C++ libraries. Basics of event based programming: methods of Windows programming, Win32 API, message based programming, Visual C++ development environment, application development and debugging, examples. (4 credits)

Advanced Technology of Broadcasting

BMETKVIMX78

Dr. Mihály Szokolay

Subsidiary services of broadcasting: program associated services, value added services. Digital channel model: Markov-type models, evaluation of measured data. Characterisation of receiving systems: problems of the interface, noises in receivers. Digital program radiation from satellites: digital video programs, digital sound programs, the Worldspace satellites. Future developments of broadcasting: program transmission on demand, program transmission by Internet. Measurements of DAB receiver, measurements of sensitivity and interface, measurement of the error rate. (4 credits)

Technology of Digital Broadcasting

BMETKVIMX79

Dr. Mihály Szokolay

System-technique of the digital broadcasting. Techniques of compression of the program signals. Transmission of digital broadcasting signals. Construction of the radio networks for digital broadcasting. Digital Sound broadcasting systems. Digital TV broadcasting systems. Digital broadcasting in Medium Wave and Short Wave Bands. Future development of broadcasting. Measurements of digital broadcasting receivers. (4 credits)

Engineering Problem Solving

BMETKVIMX75

Dr. István Vajda

Principles of inventive problem solving. Search for identification of engineering problems. Exploration of problems. PS cycle. Support to decision making. Theory of TRIZ. Principles of physical modelling. Examples of PS. (4 credits)

Microwave Sensors

BMETKVIMX73

Mr. Ferenc Völgyi

Surface sensing systems and techniques. Microwave sensing components. Sensing signal and data processing. Microwave sensing applications. Propagation of sensing signals. Properties of materials encountered in microwave sensing applications. (4 credits)

Building Management Systems

BMETKVIMX74

Dr. István Berta Mr. István Kiss Mr. Balázs Novák

Tasks of building management systems. The role of electric devices in power distribution networks. Summary of building electricity, supply, low voltage power networks. Security and safety systems, fire indicating equipment. Structure of building management systems, properties, design of centralised and decentralised systems. Structure and properties of European Installation Bus (IEB). Structure and specification of EIB devices. Design, organization, installation and commissioning projects. Power quality and electromagnetic compatibility aspects. (4 credits)

Distributed Enterprise Systems

BMETKVIMX67

Dr. Hassan Charaf

Java platform: Servlet technology, JSP technology, EJB technology, JDBC technology, Java 2 enterprise application architectures. .NET platform: .NET framework execution environment, ASP.NET technology, ADO.NET technology, .NET enterprise application architectures. (4 credits)

Software Development Processes

BMETKVIMX68

Dr. Hassan Charaf Mr. Zoltán Benedek

Overview of software development processes. Overview of the Rational Unified Process (RUP). RUP key concepts and essentials. RUP phases. The Inception phase. The Elaboration phase. The Construction phase. The Transition phase. Major RUP disciplines. Major RUP roles and activities. Major RUP artefacts. (4 credits)

Modelling of Multicast Transport

BMETKVIMX70

Dr. Gábor Hosszú

General properties of multicast transport. Basic ideas and principles of performance estimation in multimedia streams. Multicast traffic characterisation in a discrete-time system. Model of multiplexing. Estimation of multicast routing performance. Comparison of different multicast routing algorithms. Properties of the leaky bucket regulation. Multicast related service guaranties. (4 credits)

Theory and Application of Superconductors

BMETKVIMX71

Dr. István Vajda

Historical overview. Perspectives and realized applications of superconductors. Basic phenomena of superconductivity, critical parameters. Low and high temperature superconductors. Basics of cryogenics, specific cooling power. Characteristics of Type I superconductors. The Meissner-effect and the Meissner state. Silsbee's hypothesis and the critical current of Type I superconductors. The intermediate state. Characteristics of Type II superconductors. Critical magnetic fields of Type II superconductors. Comparison of the intermediate and mixed states. Characterization of pinning and the pinning centers. The critical state model. Critical current of Type II superconductors. AC losses and stability of Type II superconductors. Superconducting parts. Bulk high temperature superconductors. Low and high temperature superconducting wires and tapes. Design principles and methods of superconducting electrical power devices and systems. Superconducting magnets and their applications. Superconducting magnetic energy storage devices. Superconducting magnetically levitated bearings. Superconducting energy storage flywheels Superconducting fault current limiters and transformers. Superconducting power cables. Superconducting rotating electrical machines. Integrated superconducting systems. Economical aspects and competitiveness of superconducting devices and systems. (4 credits)

Microprogrammed System Design

BMETKVIMX69

Dr. Ferenc Kovács

Ethernet interface circuits. High-speed line interface circuits. Configurable processor controlled data switching circuits and their applications for packet transfer. Internet oriented dedicated processors, programmable configuration hardware of communication protocols. Application of FPGAs for network elements. (4 credits)

Performance Evaluation Tools

BMETKVIMX77

Mr. Csaba Simon

Protocol evaluation techniques: analysis, simulation, measurement. Simulation tools: timeline, event handling, levels of abstraction. Commercial and public simulators: OPNET, PlasmaSim, NS2, NIST, GloboSim. Simulation with NS: structure, building a simple network, using the transport layer protocols, routing and resource reservation protocols queuing in NS. (4 credits

Computer Telephony Integration

BMETKVIMX80

Mr. Csaba Simon

Session Initialisation Protocol: principles, services. H.323: architecture, presentation of a test-bed. SIP-H.323 internetworking. Telephony Services Application Programming Interface. Telephony Application Programming Interface. Computer Supported Telecommunications Application. Internet Call Centers. (4 credits)

Global System for Mobile

BMETKVIMX81

Mr. Csaba Simon

Overview of current cellular architectures. GSM: system architecture, radio resource-management, encoding, handoff, GPRS. UMTS: service concept, system architecture. (4 credits)

Analysis of Signals

BMETKVIMX82

Dr. Ferenc Kovács

Mathematical analysis methods. Fourier transformation. Fast Fourier transformation. Digital filtering. Recognition of periodic signals in noisy environment. Stochastic signals. Voice pattern recognition. Programming methods. Pattern identification using role based methods. Case studies. (4 credits)

Internet Based Communication

BMETKVIMX83

Dr. Gábor Hosszú

Overview of the Word Wide Web system. The HTML and other web languages. Learning the databases under Linux operating system. Internet based broadcasting. Theory of multicast systems. Group management and routing protocols. Reliable multicast transmission, protocols and applications. Multicast Backbone. Redundant transmission over best effort networks. Resource reservation. Communication infrastructure for streaming services. The Wireless Application Protocol, the Wireless Markup Language. (4 credits)

Mathematical Statistics and Random Processes

BMETKVIMX84

Mrs. Judit Győrffy

Statistical population, random sample. Point estimators, confidence intervals. Testing hypotheses, parametric and non-parametric tests. Regression function. Failure-time of distributions, life-testing (exponential model, Weibull model). The element of a queuing system. Cost equations, the M/M/1 queue and the M/M1C multi-server system. (4 credits)

Windows Programming in Delphi

BMETKVIMX85

Mr. Bertalan Tóth

The Object Pascal: the structure of a Windows application, the parts of a Delphi project, object-oriented programming (classes, inheritance, polymorphism). Visual application development: forms and components, component-based software development. Using graphics: graphical controls, drawing, painting, using bitmaps. (4 credits)

Development of Multimedia

BMETKVIMX86

Mr. Kálmán Fazekas

Hypermedia concepts. SGML basics. Basic HyTime concept. Structure of HyTime. Locating Data objects: naming, counting, querying. HyTime query language. WWW concepts. HyperText Transfer Protocol. Uniform Resource Locator. HyperText Markup Language. Streaming multimedia. Desktop audio and video: capturing, editing, compression. Streaming audio. Streaming video. Multicasting. Live Demos. Developing software: Power Point, Multimedia Toolbook II, Adobe. (4 credits)

Wideband Antennas

BMETKVIMX87

Mr. Ferenc Völgyi

Introduction: wideband antennas for SPR-applications. Frequency independent antennas: equiangular antennas, log-periodic antennas and arrays. Travelling-wave antennas. Broadband horn-antennas. Wideband micro-strip antennas and arrays, broad-banding techniques. Polarizations techniques. (4 credits)

Surface Penetrating Radars

BMETKVIMX88

Mr. Ferenc Völgyi

System design: range, clutter, depth resolution, system considerations. Properties of materials: propagation of waves in dielectric materials, properties of lossy dielectric materials (water, ice, permafrost), properties of soils, rocks, and man-made materials. Modulation techniques: amplitude modulation, FMCW radar, synthesized or stepped-frequency radar, single-frequency methods, polarisation modulation. Signal processing: A- B- and C scan processing, image processing. Applications: target-specific applications, NDT, geophysical and archaeological applications, civil engineering applications, roads, remote sensing. Equipment. (4 credits)

Predictive Control for Linear and Nonlinear Systems

BMETKVIMX89

Dr. Ruth Bars Dr. Róbert Haber

Summary of control methods. Introduction to predictive control. Linear and nonlinear process models. Different algorithms for predictive control. Tuning. Handling of constraints and robustness. Simulation examples using MATLAB/SIMULINK environment. Case studies. (4 credits)

Control of Electrical Machines and Drives

BMETKVIMX90

Dr. Sándor Halász Dr. István Vajda

Construction and design of rotating electrical machines. AC and DC windings. Winding selection principles. Determination of main dimensions of AC and DC machines. Magnetic circuits of rotating machines. Calculation of main field and leaking reactances. Core and winding losses. Effect of harmonics. Elements of electromagnetic field calculation. The use of commercial CAD software packages. Pre-processing and post-processing. Modelling of electromagnetic devices and machines. Large adjustable speed drives. Converter fed asynchronous and synchronous motors. Motors and inverters for 12-pulse arrangements. Cyclo-converter fed synchronous motors. Slip recovery system with sub/super-synchronous converter cascade. Energy optimized electrical drives. (4 credits)

Protocols for Telecommunication Networks

BMETKVIMX91

Mr. Kálmán Fazekas

The telecommunication environment, technological trends. Physical constraints, telecommunication channels, transmission rates. Switching techniques. Classes and structures of networks. Reference models. Physical layer protocols. Interfaces. Data link layer protocols. Network layer protocols. Transport layer protocols. Internetworking architecture for multimedia communication over heterogeneous networks. Human perception of audio-visual skew. Application in the field of multimedia technology. (4 credits)

Satellite Broadcasting Theory and Measurements

BMETKVIMX92

Dr. Mihály Szokolay

Historical background. Satellite orbits. The wave propagation between the satellites and terrestrial stations. Noise sources in the satellite radio channel. Covering an area. Techniques for satellite broadcasting systems. The processes of modulation for satellite broadcasting. Broadcasting from satellites. Comparing the properties of different broadcasting systems. The future of program transmission. Measurements of radio broadcasting receiving systems. Computer simulation of radio channels. (4 credits)

Telecommunications Management

BMETKVIMX93

Mr. László Kunsági

Sector organization, management and financing. Pricing and tariff policy. Restructuring the telecommunications sector. Marketing strategies. Strategy making policy. (4 credits)

CATV-Electronics

BMETKVIMX94

Dr. Gábor Mátay Mr. Ferenc Völgyi

Fundamentals of CATV-electronics: system configuration, transportation trunk, distribution of programs, coaxial cable and equalization, power of CATV system, passive devices and active elements, modulators and demodulators, test instruments and measurements. RF and microwave circuits, LNCs: block scheme of LNC and AM-micro, fundamentals of transmission lines, Smith-diagram, impedance matching, S-param-

eters, gain, noise figure, nonlinearity, earth station antennas, micro-strip antennas, polarisation switching, filters and multiplexers, preamplifiers, down converter mixer using Shottky-diode or FET, local oscillator stabilized by dielectric resonator. (4 credits)

Application of Internet Databases in Circuit Design

BMETKVIMX59

Dr. Gábor Hosszú

Computer aided design systems. Circuit design and synthesis based on hardware description language. The most popular microprogramming circuit. The basics of the Internet based communication. Theoretical questions of the data-transport through the Word Wide Web. Usage ofthe remote databases in digital system development. The question sof the remote access of CAD systems developed in the Dept of Electron Devices, BME. Conditions of portable circuit design. Implementation of digital system design into different technological environments. Methods of creating designer information centre. Software guard methods again breaking through the network. (4 credits)

Modelling and Design of Fast Arithmetic Systems

BMETKVIMX95

Dr. Gábor Hosszú

Theoretical questions of the computer arithmetics. Methodology of computer arithmetic and number systems. Design of two-operand adders and substractors. Theory of signed digit arithmetic. Standard and recoded multipliers. Arithmetic logic units. Standard dividers. Modelling of floating-point arithmetics. (4 credits)

ATM Networks

BMETKVIMX96

Dr. Do Van Thien

Introduction, B-ISDN service requirements, motivations for ATM. B-ISDN principle, ATM network architecture, OSI layering principle, B-ISDN protocol reference model, network layering, ATM cell, Virtual Channel Connection, Virtual Channel Link, VCI, Virtual Path Connection, Virtual Path Link, VPI, Physical Layer. Service Classes, ATM Adaptation Layer, AALl, AAL2, AAL3/4, AALS, Traffic Control, Usage Parameter Control, Priority Control, Congestion Control, Inter-working with existing networks, IP over ATM. Performance issues of ATM networks, cell loss, cell delay, message loss. (4 credits)