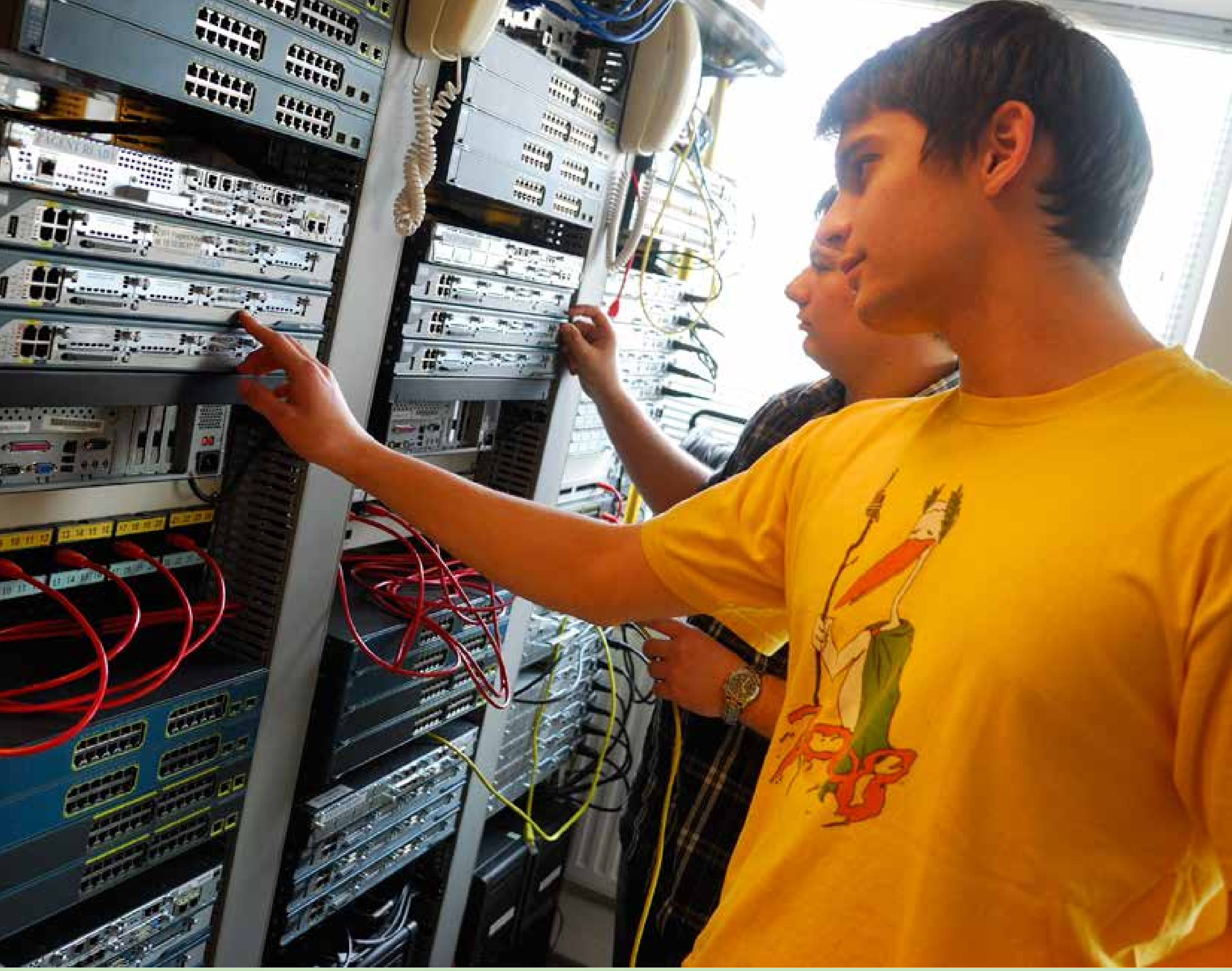

COMPUTER SCIENCE ENGINEERING

No.	Neptun Code	Subjects	Semesters																																			Prerequisites		
			1.					2.					3.					4.					5.					6.					7.							
			lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr			
Basics of Natural Science																																								
1	NAMAN1SEND	Calculus I.	3	2		ex	5																																	
2	NAMAN2SEND	Calculus II.						3	2		pm	6																											1		
3	NAMBS1SEND	Introduction to the Theory of Computing I.	3	2		ex	5																																	
4	NAMBS2SEND	Introduction to the Theory of Computing II.						3	2		pm	6																											3		
5	NAMMS1SEND	Mathematics Final Exam									s																												2	4	
6	NAMVS1SEND	Applied Probability And Mathematical Statistics																2	2		ex	5																	5		
7	NIRIA1SEND	Basics of Information Systems	2	2		pm	4																																	
8	KVEFI1SEND	Physics	2	1		ex	5																																	
9	KVEVI1SEND	Electrical Engineering						3	1		ex	5																											8	1	
Economical and Human Knowledge																																								
10	GGTKG0SEND	Economics I-II.	3	1		pm	6																																	
11	GSVVG0SEND	Business Economics											3	1		pm	6																						10		
12	GVMME0SEND	Management																					3			pm	4												11		
13	GGTJA1SEND	Legal and Government Administrative Studies																					2			ex	4												11		
Basics of Profession																																								
14	NSTPR1SEND	Programming I.	3		2	ex	6																																	
15	NSTPR2SEND	Programming II.						3		2	ex	6																											14		
16	NSTPR3SEND	Programming III.													3	pm	3																						15		
17	NSTMP1SEND	Modern Programming Language													2	pm	2																						15		
18	NSTAB0SEND	Database Management											2		2	ex	4																						15		
19	NSTST1SEND	Software Engineering I.											2			ex	3																						15		
20	NSTST2SEND	Software Engineering II.																		4	pm	5																	19	16	18
21	NSTSS1SEND	Technical Final Exam																			ce																		25	20	
22	NIRIT0SEND	Control Engineering																2		1	pm	3																	25		
23	NIRDT0SEND	Digital Technology						2		2	ex	4																											3		
24	NIREL0SEND	Electronics											2		2	ex	4																						9	23	
25	NIRDR0SEND	Digital Systems											3			ex	3																						9	23	
26	NIRSA1SEND	Fundamentals of Computer Architectures I.																2			ex	2																	25		
27	NIRKA1SEND	Advanced Computer Architectures																															2			ex	2		28		
28	NIRSA2SEND	Fundamentals of Computer Architectures II.																					2		3	pm	5												26		
29	NIROP0SEND	Operating Systems											2		3	ex	5																						7		
30	NIRSH0SEND	Computer Networks																3		2	ex	5																	29		

No.	Neptun Code	Subjects	Semesters																																			Prerequisites		
			1.					2.					3.					4.					5.					6.					7.							
			lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr			
31	NIRBR1SEND	Introduction into Embedded Systems																		2	pm	2																16	23	
32	NIRIR0SEND	Intelligent Systems																2		2	pm	4																7	16	
33	NSTVI1SEND	Enterprise Information Systems																2			ex	2																18	19	11
34	NSTVI2SEND	Modelling of Business Information Systems																							2	pm	2											33		
35	NIRIB0SEND	Fundamentals of Informatics Security																										2		2	ex	4						6	30	
36	NSTFN1SEND	Formal Languages and Automata																										2			ex	2						21	5	
37	NSTDR1SEND	Decision Support Systems																										2			pm	2						32	21	
38	NIRIK1SEND	Infocommunication Techniques																					2			pm	2											30		
Supplementary Subjects																																								
41	GTSTESTNEV	Physical Education I.							2		pm																													
42	GTSTESTNEV	Physical Education II.												2		pm																								
Common and Optional Subject of Specialisation																																								
50	NAMRA1SENC	Basics of Robotics																					2			ex	3													
51	NAMRK1SENC	Kinematics and Dynamics of Industrial Robots																					2	1		ex	3													
52	NAMRM1SENC	Robotmechatronics																					1		1	ex	2													
53	NAMRL1SENC	Application of Robots																										1			ex	2								
54	NAMIR1SENC	Intelligent Robot Systems																										1			ex	2								
55	NAMRI1SENC	Robot Control																															1		1	ex	3			
56	NAMMR1SENC	Mobil Robots																															2		1	ex	3			
57	NAMFR1SENC	Fuzzy Systems in Engineering																										2		1	ex	3								
58	NAMAM1SENC	Basic Mathematical Methods in Engineering																										1		1	ex	2								
59	NAMMS1SENC	Engineering Calculation Methods																															1	1		ex	2			

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

BASICS OF NATURAL SCIENCE

1 Calculus I. NAMAN1SEND
Dr. Endre Pap full professor

The aim of the course is to bring students coming from different secondary schools to the same level and to introduce them to the bases of one-variable calculus.
The course material is based on revision of secondary school material, numbers, algebraic formulae, equations and inequalities, functions, graphs of functions, function analysis, elementary functions, trigonometry, sequences and series, limits and continuity of functions, differentiating, numerical and symbolic derivation, applications.

2 Calculus II. NAMAN2SEND
Dr. Endre Pap full professor

The aim of the course is to acquire the basic concepts and techniques of calculus of one- and multi-variable functions according to the international trends and requirements of information specialist training. The course material consists of indefinite and definite integral and its meaning, symbolic and numerical integration, applications, plane- and space curves, differentiation and extrema of multi-variable functions, function series, integration of two-variable functions and its applications, concept of differential equations and solution with symbolic and numerical methods and examples of application.

3 Introduction to the Theory of Computing I. NAMBS1SEND
Dr. János Fodor full professor

The aim of the course is to acquire the basic concepts of analytic geometry and linear algebra which are necessary for students' further studies and for the common applications.
The course material includes Cartesian coordinate systems, vectors and vector operations, scalar and vector product, equations of straight lines and planes, linear transformations, matrices and matrix operations, linear independence, rank, inverse matrices and transformations, systems of linear equations and their solution, eigenvectors and eigenvalues.

4 Introduction to the Theory of Computing II. NAMBS2SEND
Dr. János Fodor full professor

The aim of the course is to improve the abilities of students in concept formulation, abstraction, problem solving by means of becoming acquainted with the basic topics of finite mathematics and using them in problem solving and model creation. The course material is the following: sets, set-operations, Boole-algebra, relations, equivalence classes, partial ordering, elements of combinatorcs (permutations, combinations), proof by induction, graphs, trees, applications, propositional and predicate logic and algebraic structures.

5 Mathematics Final Exam NAMMS1SEND
Dr. Imre Rudas full professor

A final exam which checks students' comprehensive knowledge of the first year's mathematical subjects, such as calculus, linear algebra, and discrete mathematics.

6 Applied Probability and Mathematical Statistics NAMVS1SEND
Dr. Ágota Cserjés associate professor

The aim of the course is to give an introduction to probability and mathematical statistics, to discuss basic concepts, to develop problem-solving skills; it provides an insight into the possibilities of practical application.
The course material contains axioms of probability, conditional probability, Bayes's theorem, independent events, geometrical probability. Discrete and continuous random variables, discrete and continuous distributions. Error estimation, Bernoulli's theorem, central limit theorem.
The students will also learn about descriptive statistics, basic concepts, sample statistics, point estimation, confidence intervals, hypothesis testing, hypotheses for normal distribution, non-parametric methods, correlation and regression.

7 Basics of Information Systems NIRIA1SEND
Dr. László Kutor associate professor

Presentation is one of the most important determining factors and theoretical basic concepts of the information technology. The core material is divided into the subject and place of the IT in the science, features of data process, analogue and digital computation, Von Neumann architecture, coding basics, information representation (digits, numbers, characters, pictures, and music).
The students will also have the chance to study minimum redundancy thesis, dictionary based data compression, code tables, adaptive compression, fault-tolerant systems (SED-SEC, Hamming code). During the seminars MATLAB will be presented in order to link their mathematical knowledge with the most important engineering software of the world.

8 Physics KVEFI1SEND
Dr. János Orosz associate professor

The course covers fluids at rest: pressure, pressure gauges, surface tension, Archimedean principle, fluid sin motion: Bernoulli's equation and its applications, laminar flow and turbulent flow, viscosity, the working fluid, heat, work and the system. Other major materials to study include state equations, The First Law, reversible and irreversible processes, Carnot's cycle, the heat engine and the heat pump, The Second Law and entropy.

9 Electrical Engineering KVEVI1SEND
Dr. Sándor Bognár associate professor

In the framework of this subject the students are presented the basic elements of the electrical circuits, structure and characteristics of the active and passive circuit elements, semiconductors, the basic laws, relations of electrical engineering, semiconductor's techniques: diode, transistors, DIAC, TRIAC. Rectifiers: 1 and 2 ways rectifying.

ECONOMICAL AND HUMAN KNOWLEDGE

10 Economics I-II. GGTKG0SEND
Dr. András Medve associate professor

The purpose of the economic and business environment. Business-types. Construction of individual and collective enterprises operating characteristics. Value-creating processes in businesses. General characteristics of firms producing products and services. Profile, operating performance capacity, lead time, production systems. Organizational forms and applications. Main features of the single-line and multi-line organization and management. Competitive activities, marketing the business. Market strategy. Resources used in the value-creation process. Utilization and economy of means. Human resource requirements planning, management and governance issues. Costing Basics. Cost planning and calculation. Ecology and measurement. Investment in the venture. Economically analyzing investments. Production management and economics. Financial and earnings position of the company management. Logistics activities and controlling.

11 Business Economics GSVVG0SEND
Dr. György Kadocsa associate professor

The content of managerial activities, activity elements. The decision as center of activity elements. Decision models. The relationship between managers and subordinates. Management style - management types. Organizational operations, organizational forms. The effective manager. Key managerial disciplines, strategy, marketing, project, innovation, quality assurance. Responsibilities of the management environment. Conflict and crisis management. Key objectives of human resource management. The functions of the Human Resources Manager. The manager and the corporate culture. Managerial aptitude, communication skills, personality development and testing. Psychology creation, creation of technical methods. Case studies of decision and responsibility for the decision and emotion - the topic of morality. Job Hunting, interviews practical demonstrations.

12 Management GVMME0SEND
Dr. István Szűts associate professor

The content of managerial activities, activity elements. The decision as center of activity elements. Decision models. The relationship between managers and subordinates. Management style - management types. Organizational operations, organizational forms. The effective manager. Key managerial disciplines, strategy, marketing, project, innovation, quality assurance. Responsibilities of the management environment. Conflict and crisis management. Key objectives of human resource management. The functions of the Human Resources Manager. The manager and the corporate culture. Managerial aptitude, communication skills, personality development and testing. Psychology creation, creation of technical methods. Case studies of decision and responsibility for the decision and emotion - the topic of morality. Job Hunting, interviews practical demonstrations.

13 Legal and Government Administrative Studies GGTJA1SEND
Dr. István Csillag associate professor

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

BASICS OF PROFESSION

14 Programming I. NSTPR1SEND
Dr. Szabolcs Sergyán associate professor

Introduction to the principles and methods of structured and object oriented programming. Introduction to an object oriented programming language. Main competencies: Concepts of algorithms, flow controls. Methods and tools of algorithm description. Data structures. Basic programming procedures: sequence calculation, decision, selection, linear search, counting, maximum selection.
Complex programming procedures: copy, assorting, intersection, union. Elementary sorting algorithms: selection sort, bubble sort, insertion sort. Binary search. Set methods. Recursive algorithms, quicksort and merge sort. Elements of the object oriented paradigm: object, class, connections between classes. Features of the object oriented methodology: encapsulation, data hiding, inheritance, polymorphism, code regeneration. Textbooks:- T.H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein: Introduction to Algorithms. (3rd edition) Massachusetts Institute of Technology, 2009 - A. Troelsen: Pro C# 2010 and the .NET 4 Platform, Apress; 5 edition (May 14, 2010).

15 Programming II. NSTPR2SEND
Dr. Szabolcs Sergyán associate professor

Outline of programming paradigms. Constructors in inheritance. Methods hiding. Inheritance and ancestor references. Polymorphism. Abstract class and interface. Iterators. Components. Operator overloading. Exception handling. Generics.Advanced sort algorithms. Dynamic array. Simple and one directional sorted linked list. Other evaluation of linked lists. Evaluation of queue and stack. Binary search tree. Red-black tree. B-tree. Heaps. Directed and undirected graphs. Spanning trees, Kruskal algorithms. Graph walks. Path searching. Determination of connected components. Topological sort. Hash tables. Textbooks: - D. Clark: Beginning C# Object-Oriented Programming. Apress, 2011 - A. Troelsen: Pro C# 2010 and the .NET 4 Platform, Apress; 5 edition (May 14, 2010).

16 Programming III. NSTPR3SEND
Dr. Zoltán Vámossy associate professor

Revision and practice using OOP. Introduction to the .NET framework: managed code, Intermediate Language, native code, memory management, garbage collection. Introduction to the .NET Class library, its namespaces, basic classes and components. Usage of simple controls and events, designing a Graphical User Interface, arranging controls. MDI application development. Delegates and events. File and stream management for different types of storage, synchronous and asynchronous operations. Graphical possibilities using the System.Drawing namespace. Performing tasks using timer-based animation. Using and creating DLL files. Textbook: A. Troelsen: Pro C# 2010 and the .NET 4 Platform, Apress; 5 edition (May 14, 2010).

17 Modern Programming Language NSTMP1SEND
Dr. László Erdődi senior lecturer

Introduction to the Object-Oriented Programming Paradigm and related technologies using the Java programming language. Creating and using objects (fields, constructors, methods, getter-setter pattern) and classes. Visibility and encapsulation. Implementation of inheritance. Access levels. Using packages. Abstract classes and interfaces. Using the built-in class library. Exception handling. Developing console applications. Developing web applications. Introduction to dynamically generated web pages based on HTML and HTTP. Creating Java servlets: Model-View-Controller design, life-cycle of servlets, parameter handling (POST and GET method), text and binary output generation, session handling (cookies, hidden fields, parameterized URL, session API). Introduction to JavaServer Pages: syntax, directives, runtime compilation, request dispatching. Textbook: B. Spell: Pro Java Programming, Apress; 2nd edition, (2000).

CSE

18 Database Management NSTAB0SEND
Dr. Domonkos Tikk associate professor

Lectures: Data, information and information processing. Goal-oriented information processing. Consecutive and non-consecutive file structures. Database oriented information processing. Data modeling. Entities, attributes, relationships. Data independency, DDL, DML. Database administration. Database management models. The hierarchical, the nested, and the relational approach. Using the relational model. Anomalies, normalization. Relational algebra, calculus. SQL, extended tools. The EER model. Object-oriented databases. Deductive systems, knowledge bases. Database architectures. Client-server architectures. Distributed systems. Data security and safety. Data authentication. Physical, procedural, algorithmic protection. User and partner identification. Encoding, decoding. Message authentication. Accessing protection. Digital signature. Newest demands. OLTP, OLAP, ROLAP, MOLAP. Data warehouses, data marts. Data mining. Lab sessions: The students learn how to plan, construct and query databases, and how to program in an interactive and embedded way on the ORACLE platform.Other topics include: database planning, normalization (0NF, 1NF, 2NF, 3NF, BCNF), anomalies. Using the SQL*Plus interactive environment in the ORACLE system. Queries using the SQL SELECT statement. Joining the tables, subqueries. DML commands, database transactions. DDL commands, creating tables, data types, constraints, views.DCL statements, handling the authorities. PL/SQL blocks, control constructions, complex data constructions, cursors, ROWID. Handling exceptions, sub-programs, triggers, applications. Textbook:- K. Loney, Oracle Database 10g: The Complete Reference, Osborne (2004)

19 Software Engineering I. NSTST1SEND
Dr. József Tick associate professor

The lectures' aim is to present the fundamental paradigms of Software Engineering, especially the methods of software design and development, focused on object-oriented and component based techniques. The lectures cover the following topics: the basics of software engineering, software development paradigms, traditional life cycle models, early methodologies of OO software development (OOD, RDD, OOAD, OMT), object-based modelling, Unified Modelling Languages, the models of UML, software development with UML, UML profiles, Model Driven Architecture, Design Patterns, the Rational Unified Process. Compulsory textbooks: I. Sommerville: Software Engineering, 8th edition, Pearson Education Limited, England 2007. R. S. Pressman: Software Engineering: A Practitioner's Approach 6th edition, McGraw-Hill, New York 2005.

20 Software Engineering II.NSTST2SEND
Dr. Zoltán Vámossy associate professor

The laboratory sessions consist of two parts: the first part provides training the skills of software development by UML and RUP in teamwork, to learn the best practice in application development by case-tools. The second part introduces new technologies of .Net framework: using attributes and reflection, shows application development using lambda expressions and LINQ, XLINQ and LINQ to Entities, introduces the ADO.NET Entity Framework, its structure and data modelling (EDM). In the framework of the course the students study application development for data manipulation (update, insert) using Database Engine Queries, entities and associations, process management: starting processes from static methods and objects, usage of the Enable Raising Events and Has Exited properties, thread management: initialization, priority, state, state transition diagram for background and foreground threads. The course also deals with grouping of threads: Thread Pool, introduction to thread-synchronization problems (locking, monitoring, and waiting), parallel algorithms: Parallel.For. Recommended textbooks are the following: I. Sommerville: Software Engineering, 8th edition, Pearson Education Limited, England 2007.R. S. Pressman: Software Engineering: A Practitioner's Approach 6th edition, McGraw-Hill, New York 2005. A. Troelsen: Pro C# 2010 and the .NET 4 Platform, Apress; 5 edition (May 14, 2010).

21 Technical Final Exam NSTSS1SEND
Dr. László Csink associate professor

A final exam which checks students' comprehensive knowledge on software engineering and digital technology courses: Programming I-III, Software Engineering I-II, Digital Technology and Digital systems.

22 Control Engineering NIRIT0SEND
Dr. László Nádai associate professor

Theory: Open loop control system, closed loop systems, linear, time-invariant, continuous control systems, Block diagrams, some illustrative examples. Modelling Formulation of equation of Linear electrical, mechanical systems. Use of Laplace-transform, Transfer function, concepts of state variable modelling. Block diagram representation signal flow graphs and associated algebra, characteristics equation. Time Domain Analysis Typical test - input signal, Transient response of the first and second order systems. Time domain specifications, Dominant closed loop poles of higher order systems. Steady state error and coefficients. Pole-zero location and stability. Frequency Domain Analysis Closed loop frequency response, bode plots, stability and loop transfer function. Frequency response specification relative stability, relation between time and frequency response for second order systems. Series compensations.

23 Digital Technology NIRDT0SEND
Dr. András Molnár associate professor

Theory: Introduction to digital technology, digital signals views. Logical circuit one and two variable, Boolean algebra, ways to describe logic functions. Minimization of logic functions. Combination Logic members, decoders, multiplexers, comparators. Sequential logic circuits, flip-flop, shift registers, counters, memories. Basics of Computer Science, the internal layout of your computer. Fundamentals of microprocessor technology. Single microcomputers. Laboratory: Basics of VHDL language and schematic design. Designing, creating and simulating one and two variables logical circuits width CAD software. Design of complex logical and sequential circuits.

24 Electronics NIREL0SEND
Dr. László Nádai associate professor

Nowadays, the mostly digital world also requires a basic knowledge of analogue circuits. In this course the students will learn about the basic principles of analogue circuits design and operation. The students will examine discrete components such as resistors, capacitors, diodes and transistors as well as integrated components such as operational amplifiers. In addition, the students will become familiar with the operation of basic electronic circuits

25 Digital Systems NIRDR0SEND
Dr. András Molnár associate professor

Theory: There has been a tremendous development in digital circuits over the past 3 decades, and there are a number of approaches for implementation of digital circuits. This course intends to give a background on digital electronics. The course will cover various circuit families, including diode-transistor logic (DTL), transistor-transistor logic (TTL), NMOS, and CMOS logic. In addition, various other circuits used in digital world will be covered. These include regenerative circuits, Schmitt-triggers, integrated circuits, RAMs, ROMs. The second part of this course is an introduction to VHDL programming: VHDL – Overview, Concepts of VHDL, Modularity and Hierarchy, VHDL Language and Syntax, VHDL Structural Elements, Data Types, Operators, Concurrent and Sequential statements, Synthesis, Example codes.

26 Fundamentals of Computer Architectures I. NIRSA1SEND
Dr. Péter Broczkó associate professor

The lectures present relevant knowledge about instruction level architectures and the microarchitecture of traditional Neumann computers. The material presented is based on the design space approach. Case examples and major trends will be given to illustrate the evolution. Major topics include: Computational models, programming languages and architectures. Data based computational models, the von Neumann computational model, and data flow computational model. The concept of computer architecture and different levels of abstraction. The students will also study main dimensions of the Instruction Set Architecture (ISA), memory space and register space. data types, operations, operand-types, instruction formats, addressing methods, user visible status characteristics, operations, and introduction to processor architectures. In the framework of this subject students are presented centralized and decentralized control, execution units, basics of bus-systems, alternatives of organizing bus operations, signal systems, classes of bus systems, parallel and serial buses, speed limit of parallel buses, basic characteristics of parallel and serial buses (FSB, PCI, PCIe, HT, QPI). The core material contains programmed I/O, memory mapped I/O, DMA, I/O channel, the interrupt system, operation of DRAMs, types of DRAMs (SDRAM, DDR, DDR2, DDR3), characteristics of DIMMs (UDIMM, RDIMM, ECC), architecture and principle of operation of a hypothetical computer.

27 Advanced Computer Architectures NIRKA1SEND
Dr. Péter Broczkó associate professor

Main objective of the presented material is to identify decisive aspects and main steps of the evolution of advanced processor and system architectures. The subject discussed is based on the design space approach, emphasizing main aspects and options for each step of the evolution as well as major trends identified. Many case examples illustrate the material presented. Main competences aimed at include classes of multicore and manycore processors, sub-classes of homogeneous multicore processors. Main aspects of the implementation of recent multicore processors, such as power management, alternative implementations of the turbo boost technology, processor level support of the virtualization, alternative ways to achieve cache coherency, basics of the remote management of processors. Implementation aspects and examples of manycore processors. Main classes of heterogeneous ad-on processors. Heterogeneous master-slave processors. Execution paradigm and micro-architecture of GPGPU-s. Main dimensions of platforms. Implications of increasing core counts to system architecture. Main steps of the evolution of Intel's, AMD's, IBM's, ARM's processor and system architectures, case examples.

28 Fundamentals of Computer Architectures II. NIRSA2SEND
Dr. Péter Broczkó associate professor

The lectures provide an overview about main classes of parallel architectures such as: pipeline, superscalar and VLIW processors. The material presented is based on the design space approach. Case examples and the identification of major trends concerning the evolution enhance the lectures. Major topics include levels of the utilized parallelism, Flynn's and an updated classification of architectures, data, control and resource dependencies and basic methods of their handling, preserving sequential consistency, pipelined processors, superscalar processors of 1st, 2nd and 3rd generation and ISA enhancements (MMX, SSE, etc.).
The students will also learn about layout alternatives of caches, 2-3 level cache-hierarchies, optimum size of caches, trends, examples, VLIW and EPIC architectures, thread-level parallel, fine and coarse-grained, and SMT architectures, process-level parallel architectures and motherboards. Objectives of the lab exercises are the following: to give an overview of major processor architectures, registers and instructions, execution mechanisms of machine-level programs, their connection to operating systems, basics of compilers, structure of executable files (architecture of .COM and .EXE files). Writing simple sequential programs, iterations and input/output operations, writing programs for calculations, data conversations and simulations, displaying and programming of peripheral equipment (displaying graphical elements, handling of serial and parallel ports) belong to the requirements of the course.

29 Operating Systems NIROP0SEND
Dr. András Rövid associate professor

The main tasks of the operating systems are evolution of the components and its appearance in the popular operating systems (Windows, Unix, and Linux versions). The students can use command line tools and different operating systems in the lab. The Linux system is the primary platform for the exercises; however, certain areas of the Windows system solutions will be presented too. Key skills for students to acquire: operating systems architecture, main operating system features and modules (process and thread management, scheduling, memory management, i/o and file management, communication between processes), the factors of development, and the need and opportunities to standardize the adapter interfaces, solutions in the widely used operating systems.

30 Computer Networks NIRSH0SEND
Dr. Miklós Kozlovszky associate professor

The students are introduced to the structure and operation principals of computer networks. They learn about basic terms, implementation principals and methods and reference models. The students acquire knowledge of TCP/IP family, structure of internet, addressing scheme, IP protocol, and its directions of further development, and finally the operation of basic protocols which provide the basic functionality of the modern internet. The students learn about the basic physical transmissions medium in computer networks and its operating modes and features. They get an overview of computer networks, operating methods, application possibilities and the expected performance.
Key competencies for students to reach: Network reference models, Internet principles, the addressing and name handling policies, the IP protocol operating mode, the connection-free and connection-oriented characteristic of data transfer and transport protocols. Local network techniques, Ethernet networks, switching and routing, Wide area network technologies.

31 Introduction into Embedded Systems NIRBR1SEND
Dr. András Molnár associate professor

Students are introduced to modern embedded systems. ARM-based C # .Net programmable environment device. The practice provides a link between the ""classical"" programming and the target hardware. The course starts from a ""hello world""-type program to complex computer games and by different simulations guides the students in hardware and software applications. Key skills for students to possess: hardware-based programming, use of peripheral devices, use of sensory data, graphical LCD programming, touch screen use, CCD camera using solid-state storage devices. The exercise involves the preparation of the hardware components and appropriate program creation. The students will come into contact with peripherals and software modules necessary for their operation relationship which is essential to any writing program of embedded systems.

32 Intelligent Systems NIRIR0SEND
Dr. László Kutor associate professor

Definition and measurement of intelligence (IQ, EQ). Biological intelligence. Machine intelligence (sensing, knowledge, learning, data process, execution, communication). Biological and technical sensors. Knowledge representation, machine learning. First-order logic, semantic networks. Problem solving solutions (distributed, concentrated). Biology based information process (artificial neural networks, fuzzy logic, genetic algorithms) Agent technology basics and solutions. Neural network design and implementation. Expert systems, decision support systems. Mobile robots and navigation, satellite positioning.

33 Enterprise Information Systems NSTVI1SEND
Dr. László Erdődi senior lecturer

Ground Concepts: information system, IT, IT resources and their classification, requirements against information and IP. External Information Model: customers, suppliers, the financial sector, government, typical data flows. Goods, Stock in Hand: changes, typical flows, the data model. Customers, Suppliers: fundamental concepts, activities, the data model. Service of Customers: quotation, order, business transactions, data model, and relations to other subsystems. Procurement: request for proposal, order, business transactions, data model, and relations to other subsystems. Invoicing: preparing an invoice, invoice processing, returning goods, connected tasks, data model, relations with other subsystems. Financial Issues: accounts receivable and payable, connected tasks, data model, relations to other subsystems. Service Functions of the System: event based/time based functions, risks and controls, user roles. Communicating with Partners: Paper – based, EDI, E-business. The History of IS's: from the isolated subsystems to the integrated standard systems, HW/SW background.

34 Modelling of Business Information Systems NSTVI2SEND
Dr. László Erdődi senior lecturer

Project work gives a base to this course. The students acquire practice in teamwork, in designing business processes and related data models and subsystems. They will focus on decomposition of a system to functional subsystems, allocating subsystems to teams, designing business processes relating to the subsystems, design of the data models of the subsystems, design of relations among subsystems, design of procedures and inputs, design of input control, design of outputs, tools to be used for design: process modelling software (e.g. ARIS or Signavio), or a CASE tool.

35 Fundamentals of Informatics Security NIRIB0SEND
Dr. Valéria Póser associate professor

An overview of the history of information security. Ethical issues, the importance of developing policy. Motivations, targets. Symmetric encryption methods (DES, 3DES, AES). Asymmetric encryption methods (RSA), authentication, digital signature. MAC. Hash functions (MD4, MD5, SHA1). Block cipher modes of operation (ECB, CBC, CFB, OFB, CTR). Message Authentication (CBC MAC). Hash functions-based MAC functions. The basics of the protection networks. Use and configuration the firewalls, fine tuning. Intrusion detection, IDS/IPS. Internet security protocols (SSL, TLS). Scan of foreign computers, vulnerability testing. Secure communications. Secure mail and data storage (PGP). Key exchange protocols, authentication. Viruses, virus protection. Password control of operating systems. Password choice problems, password decryption. Dictionary-based password break, brute force, the properties of a good password, password recovery programs.

36 Formal Languages and Automata NSTFN1SEND
Dr. László Csink associate professor

Fundamentals of formal languages. Formal grammars and their normal forms. The Chomsky hierarchy. Deterministic and nondeterministic finite automata. Recursivity. Bar-Hillel theorems, Kleene theorem, MyHill-Nerode theorem. Context-free languages. Compliers. Recursive languages. Syntactical analysis using special grammars (LL, LR). Turing machines. Programming with a Turing machine. Applications of finite automata: lexical analysis, pattern recognition. String matching with an automaton. Textbook: J. Hopcroft, R. Motwani, and J. Ullman: Automata Theory, Languages, and Computation (3rd edition), Addison-Wesley, 2007.

CSE

37 Decision Support Systems NSTDR1SEND
Dr. László Csink associate professor

The goal is to make students able to analyze problems using DSS and BI tools.Main topics: Fundamentals of decision theory, its main processes, history of decision support systems (DSS). Typical services and technology of DSS, group DSS, online analytical processing (OLAP), expert systems, learning systems, and data mining. Effective business intelligence systems. Creative computer software. Idea processing systems. Knowledge extraction tools. Analytical processing systems, corporate planning. Knowledge discovery software, business intelligence software. Data mining products, marketing decision makers. Financial intelligence. Textbook: J. E. Aronson et al: Decision Support and Business Intelligence Systems (8th Ed.), Prentice Hall, 2007

38 Infocommunication Techniques NIRIK1SEND
Dr. Miklós Kozlovszky associate professor

The basics of telecommunication: fundamentals of telecommunications networks, voice / speech transmission, network topologies. Technological background knowledge. Physical Basics: wired and wireless transmission media features. Evolution of microelectronics, optical transmission and radio access. Broadcasting fundamentals. Access of IP networks by telecommunication or cable-TV networks. Voice transmission data networks (VoIP). Mobile communication systems (cellular networks, GSM, GPRS, EDGE, UMTS and further developments, satellite systems, stand-by systems. Backbone techniques (P / SDH, ngSDH, OTN), as well as their development trends.

SUPPLEMENTARY SUBJECTS

41 Physical Education I. GTSTESTNEV
Györgyné Fehér trainer

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

42 Physical Education II. GTSTESTNEV
Györgyné Fehér trainer

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

COMMON AND OPTIONAL SUBJECT OF SPECIALISATION

50 Basics of Robotics NAMRA1SENC
Dr. Attila Bencsik associate professor

Classification of robots, industrial robots characteristics. Mobile robots, industrial robots, direct and indirect manipulators, master-slave systems. The basic concepts of robotics: Kinematic motion-space, work-space, coordinate systems. Basic principles of arm mechanisms, mechanical, manipulative and robotic aspects. Key elements of enforcement mechanisms. Technical implementation of degrees of freedom, characteristics and scope of the executive elements of the shoots. Direct and indirect drives, gearboxes. Measuring systems for robots. Internal and external sensors, the control aspects of design requirements. General tasks of industrial robot control: position control and tracking control and its requirements. Opportunities for teaching robots, their characteristics.

51 Kinematics and Dynamics of Industrial Robots NAMRK1SENC
Dr. Jozsef Tar full professor

Translation and rotation group properties. Discrete, continuous, and Lie groups. Group-algebra, tangent space, generators, Lie algebra Jacobi identity, representations of Lie groups. The rotation group representations: orthogonal matrices kvaternio-algebra, spinors. The homogeneous matrix representation. Robots open kinematic chaisn, general coordinates. Denavit-Hartenberg convention. The Jacobi matrix. Kinematic singularities, the Gram-Schmidt method, redundant robot arms, generalized inverse, some special kinematic structure. Newton axioms, Lagrange function. The Hamilton's principle. Euler-Lagrange equations, generalized forces and their physical meaning. The dynamic model set up by measurements and homogeneous transformations, the generalized inertia matrix. The internal symmetries of mechanical systems: Legendre transformation, Hamilton-function, canonical coordinates. Closed mechanical system of internal symmetries. The symplectic groups and symplectic geometry. Symplectic basis, symplectic algorithms, phase current, Poisson brackets, symmetry conservation principles, Liouville theorem.

52 Robotmechatronics NAMRM1SENC
Dr. Attila Bencsikassociate professor

The classification of mechatronics, its characteristics in industrial robots: basics of arm mechanisms , integrated elements of mechanical systems in manipulation, robotics point of view. Implementing elements and their application in the mechatronics robot drives. Engines in service robotics, construction requirements. Proportional servo drives and mechatronic systems for electrical, pneumatic and hydraulic enforcement agencies. Industrial robot grippers. Mechatronic units in the ends of the enforcement mechanism. Robots Monitoring: Internal and external sensors, construction, information technology requirements, designs under the control requirements. The robot's technical structure: According to the requirements of mechatronics, control-related hardware components. The practice themes: TINA-based computer simulation program practices.

53 Application of Robots NAMRL1SENC
Dr. Attila Bencsik associate professor

Types of industrial robots according to the application criteria. Terms of robotization. Technical requirements to the technology, welding, handling, painting, assembly areas. Requirements in connection with an industrial robot. Faculty mechanisms, mechanisms and mechanical systems integrated components, manipulative skills, requirements of robotic features. Economics of robotization introduction. Other aspects of robot selection: human and material, links to other elements of the technological system. Industrial robot grippers based on the robot application. Robots measurement systems, information requirements and control requirements of the application. Electrical, pneumatic and hydraulic-powered robots in a variety of technologies and services. The industrial robot according to the characteristics of the service and maintenance systems. Case studies in the area of application of industrial robots.

54 Intelligent Robot Systems NAMIR1SENC
Dr. Gyula Hermann associate professor

Interactive relationship with the environment. Intelligent sensor systems at a glance, what makes the robot intelligent? Potential amalgamation of different sensor systems. Robotic Vision Systems, description of basic methods: laser-eye stereo camera, ultrasonic systems, infrared systems and triangulation. Basic problems of mobile robots: path planning,

navigation (known and unknown environments), map making, obstacles (static and dynamic) avoidance. Marker-based position measurement is based, intelligent markers. Cooperation of mobile robots (description and basic problem of multi agent environment). Central and distributive management funds.

55 Robot Control NAMRI1SENC
Dr. Imre Rudas full professor

Kinematic control: control for position: independent axis control, track control. Dynamic control: calculated torque-based control; feedforward control; control for the force: hybrid position-force control. Traditional adaptive control: sliding control; Adaptive controls: Lyapunov's second method, Barbalat's lemma. Adaptive inverse dynamics; Slotine and Li algorithm; adaptive Slotine-Li algorithm. Soft computing contol: fuzzy robot control, neural network-based control (perceptron, Kohonen networks, Hopfield network, Elman network, CNN). Adaptive control based on fixed point transformations and SVD method. Topics of the practices: setting up special, simple models; PID-like trajectory control; Investigating the effect of Stribeck-type friction and backlash model for the quality of the control; DC motor model; servo controlled differential cylinder drive-based model. Comparison of classical and new adaptive methods by numerical examples.

56 Mobile Robots NAMMR1SENC
Dr. Zoltán Vámossy associate professor

Robotized systems: objectives, functions and general structure. Mobile robots: wheeled robots, CLAWAR machines. Static and dynamic stability of motion. Manipulation of objects in the workspace: description of tasks. Relative transformations in the working area. The use of visual information for determination of relative position. Track controls: Rough path planning methods: the use of GVD for path planning. Neural-based path planning. Fine-level path planning: interpolated motion. The use splines. Linear interpolation with parabolic transitions. Robot navigation: external sensors. The use visual information. Optical properties and applications of the PAL. Image processing techniques and basic concepts: morphological algorithms, rank order filters, noise filtering. Edge detection for split and merge edges. Pattern recognition methods. Determination of area, perimeter, torque and crankshaft.

57 Fuzzy Systems in Engineering NAMFR1SENC
Dr. Márta Takács associate professor

The role of logic in engineering systems. Bivalent, multivalent and fuzzy logic in decision-making. Fuzzy sets and operations. Rules and fuzzy models. Mamdani and Takagi-Sugeno models. Inference systems working in virtue of new operations. Matlab environment. Simulink environment. Matlab fuzzy environment. Contol models in Matlab fuzzy environment. Economic models.

58 Basic Mathematical Methods in Engineering NAMAM1SENC
Dr. Ágota Cserjés associate professor

Abstract spaces; optimum search under constraints; curve fitting for measurement data or data from tables; the Legendre transformation: variable substitution in multivariate functions: switchover to directly measurable quantities in thermodynamics: the introduction of the thermodynamic potentials. Declaration of the Hamiltonian and the canonical equations of motion in classical mechanics. Tensor fields in ordinary three-dimensional physical Euclidean space and its internal symmetries, bases of the group theory; real SVD and HOSVD and its geometric interpretation; Lyapunov function; Barbalat's lemma; Pontryagin's optimal controller, Hamiltonian; robust control, sliding control; the SVD-based adaptive control.

59 Engineering Calculation Methods NAMMS1SENC
Dr. Ágota Cserjés associate professor

The Engineering Calculation Methods' content, objective and tools. A brief overview of the applied information technology (hardware/software) and mathematical methods, and the fields of application. Computer-oriented numerical methods. Fundamental architectures and programming features. The floating-point arithmetic standard. Numerical methods of linear algebra, discretization methods, FEM (Finite element method). The effects of floating point arithmetic to the achievable accuracy and numerical stability. Arithmetic elements of the interval. Computer architectures and efficient numerical algorithms. Numerical software. Software standards and libraries (BLAS, LAPACK, etc). Special numerical and symbolic software packages (MATLAB, Scilab, Derive, Maple, etc). The graphical display techniques and devices. Simulation techniques. Monte Carlo methods, simulation languages, SIMULINK elements. Case study.