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1st SEMESTER

Course title, code: Basic Mathematics, GAINBAN-ALAPMATE-1	**Credits:** 0
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 0 (credit %), *Practice:* 100 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 0+2+0*, semester* 1	
Evaluation type: signature	
Recommended semester: 1	
Prerequisites: -	
Subject description: *Course objectives:* The aim of the course is to provide students with the basic concepts and methods needed to master higher mathematics and to fill in the gaps for the shortcomings of secondary school. *Course contents:* Vectors, operations with vectors, scalar multiplication. Solving linear equations and systems of equations. Congruence transformations. Sets of numbers. Square roots, second degree equations, inequalities. Trigonometry angle functions, notable angles and identities. Simple trigonometric equations. Series, arithmetic and geometric series, properties of series, representation. Algebraic expressions, identities of powers, notable identities. Exponential equations. Logarithm. Basic concepts of functional theory. Representation of basic functions, properties. Function transformations. Extreme value problems.	
Required readings: BIRD, John. Bird's Basic Engineering Mathematics. Routledge, 2021.	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. *b) skills:* *c) attitude:* - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* *e) additional professional competences:* - Efficient use of digital technology, knowledge of digital solutions to fulfill educational objectives	
Responsible instructor: Oszténiné dr. Krauczi Éva	
Instructor(s): Dr. Ladics Tamás	

Course title, code: Calculus 1, GAINBAN-ANALIZI1-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+2+0*, semester* 1	
Evaluation type: term mark	
Recommended semester: 1	
Prerequisites: -	
Subject description: *Course objectives:* The aim of the course is to make the students learn the basic concepts and tools of advanced mathematical analysis that are necessary and required in engineering studies and later on in their profession. *Course contents:* Three-dimensional vectors. Solving systems of linear equations. Matrices, multiplication of matrices, inverse matrix, rank. Linear transformations, eigenvector, eigenvalue. Complex numbers. Elementary operations of complex numbers. Power and nth root in trigonometric form. Real sequences and their properties. Convergence, special limits. Real functions of a single variable. Elementary functions and their properties. Limits of real functions, continuity. Differential calculus of one variable functions. Rules and procedures of differentiation. Applications of differential calculus: sketching graphs, local and global extrema, shape of curves. Solving exercises and practical problems related to the knowledge covered in the lecture, practising at skill level.	
Required readings: George B. Thomas, Maurice D. Weir, Joel Hass, Frank R. Giordano: Thomas' Calculus, Pearson, 2009.	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. *b) skills:* *c) attitude:* - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* *e) additional professional competences:* - Efficient use of digital technology, knowledge of digital solutions to fulfill educational objectives	
Responsible instructor: Dr. Végh Attila	
Instructor(s): Dr. Ladics Tamás	

Course title, code: Computer Networking Fundamentals, GAINBAN-HALOALAP-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 1	
Evaluation type: colloquium	
Recommended semester: 1	
Prerequisites: -	
Subject description: *Course objectives:* The aim of the course is for students to get to know the computer network systems and their economic characteristics used today. Know the structure of conventional networks, the basic principles, architectures and protocols of their operation, as well as small business procedures and their accompanying phenomena. *Course contents:* The basic concepts of computer networks. The OSI reference model, TCP/IP. Elements of the network, end devices, transmission devices, network transmission media. Physical, logical topology. Broadcast network. A network built from point-to-point connections, the concept of duplexity. Role of protocols. Messages (encoding, formatting, embedding, size, timing). Protocol Data Units (PDU). Data transmission on a physical channel. Wired data transmission standards. The two- and multi-port repeater. Optical fiber data transmission. Multiplexing of the physical channel (TDMA, FDMA, WDMA). The medium access (MAC) sublayer. CSMA/CD, token-ring and token-bus are public access protocols. Services of the data link layer. IEEE 802.3 standard, using MAC addresses. The role, characteristics and commands of the switch. Tasks of the network layer. The datagram and virtual circuit based transmission system. Connecting subnets in OSI layer 3: characteristics, task, commands of the router. Default gateway. The IP (v4) protocol: The structure and main information of the IP header. Structure of IP addresses. Address allocations. Network Subnetting (VLSM). The Classless Inter-Domain Routing (CIDR). Understanding DHCP. ARP and Inverse ARP protocol. Packet forwarding to remote subnet. Application of the routing table. Table-based and table-less routing algorithms. RIP, RIP2, OSPF protocol. The IPv6 addressing system. Tasks and services of the transport layer. TCP and UDP protocol services and their operation. Description of DNS (Domain Name System). Types of wireless networks. Wireless LAN standards. WLAN settings, security, VPN. Mobile network. Elements of the network, end devices, transmission devices, network transmission media. Physical, logical topology. Broadcast network. Messages (encoding, formatting, embedding, size, timing). Data transmission on a physical channel. OPB calculations. IEEE 802.3 standard, using MAC addresses. The role, characteristics and commands of the switch. Tasks of the network layer. The datagram and virtual circuit based transmission system. Connecting subnets in OSI layer 3: characteristics, task, commands of the router. Default gateway. The IP (v4) protocol: The structure and main information of the IP header. Structure of IP addresses. Address allocations. Network subnetting (VLSM). The Classless Inter-Domain Routing (CIDR).Understanding and using DHCP. Packet forwarding to remote subnet. Application of the routing table. Table-based and table-less routing algorithms. RIP control protocol. The IPv6 addressing system. WLAN settings, security. Creating a network and making settings in a simulation environment. Managing home networks.	
Required readings: [1] A. S. Tanenbaum: Computer-Networks-5th-Edition, 2011 ISBN-13: 978-0-13-212695-3. https://www.mbit.edu.in/wp-content/uploads/2020/05/Computer-Networks-5th-Edition.pdf [2] AHMADI, S.: An Overview of Next-Generation Mobile WiMAX Technology, IEEE Commun. Magazine, vol. 47, pp. 84-88, June 2009 [3] https://www.saylor.org/site/wp-content/uploads/2012/02/Computer-Networking-Principles-Bonaventure-1-30-31-OTC1.pdf. 2012.02.	
Acquired competences: *a) knowledge:* - His/her English language skills will be sufficient for the level of training, and to understand English-language literature, to process professional texts, to carry out professional tasks, as well as for continuous professional development. - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural	

sciences) relevant to the field of IT.
- He/she knows the operations of hardware and software elements, the technology of their implementation, how to solve problems related to their operation and the possibilities of the interconnection of IT and other technical systems.
- He/she posesses a basic knowledge and engineering approach to signal processing, modelling, simulation and control of systems and networks.
- He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security.
- He/she has basic data security skills.
- He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level.
b) skills:
- He/she uses the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of information technology in his/her engineering work for the design of information systems.
- Using the knowledge gained from his/her studies, he/she will be able to install and configure computer and telecommunications networks, troubleshoot network faults, operate and upgrade networks.
He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology.
- He/she is able to fulfill analytical, specification, planning, development and operation tasks, in addition, he/she applies the development methodology, debugging, testing and quality assurance methods in his/her field.
- He/she cooperates with other computer science engineers, electrical engineers during team work, and with other experts during the analysis and solution of a problems.
- He/she can communicate in Hungarian and in English about professional issues, he/she uses the terms of information technology in a creative way.
- He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession.
c) attitude:
- He/she genuinely represents the professional principles of engineering and information technology fields.
- He/she aims to see through the entire engineering system not only his/her own field.
- He/she is open to acquire new methods, programming languages and develop skills to use them.
- He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas.
- He/she makes decisions with full respect for the law and ethical standards in decision-making situations requiring a complex approach.
- He/she makes an effort to work efficiently and to high standards.
- He/she keeps in mind and ensures the security of his/her employees' and customers' data and information.

d) autonomy and responsibilities:
- He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team.
- He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them.
- He/she has a security-conscious attitude in posession of his/her professional knowledge, and is aware of potential threats and opportunities for attack, as well as is prepared to prevent them.
e) additional professional competences:

Responsible instructor:
Dr. Pásztor Attila

Instructor(s):

Course title, code: Digital Electronics 1, GAINBAN-DIGTECH1-1	**Credits:** 3
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+2+0*, semester* 1	
Evaluation type: colloquium	
Recommended semester: 1	
Prerequisites: -	
Subject description: *Course objectives:* The aim of the Digital Electronics I course is to introduce students to the theoretical foundations of digital technology and the main procedures for designing combinational circuits. *Course contents:* Digital and analogue signals. Number and coding systems: binary, octal, hexadecimal numbers, Gray, Stibitz, BCD codes. Boolean algebra. Logic gates. Logic functions and symbols. Combinational logic implementation: minimization (Karnaugh map, Quine-McCluskey). TTL/CMOS circuits. Basic logic devices: combinational MSI circuits. Logic circuit characteristics. Practice theoretical knowledge with exercises and examples. Design exercises. Learning to use a simulator.	
Required readings: Dr. Rajmund Drenyovszki, Bence Sari; Digital Electronics 1: Number and Coding Systems, Boolean Algebra, Logic Gates, Combinational Logic Implementation, John von Neumann University, 2022 Mark S. Nixon: Digital Electronics: A Primer - Introductory Logic Circuit Design (Primers in Electronics and Computer Science), 2015, Icp, ISBN-13: 978-1783264902	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. *b) skills:* He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* - He/she genuinely represents the professional principles of engineering and information technology fields. - He/she aims to see through the entire engineering system not only his/her own field. - He/she understands and embraces the ethical principles and legal implications of his/her profession. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* - He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team. - He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them. *e) additional professional competences:*	
Responsible instructor: Dr. Drenyovszki Rajmund	
Instructor(s): Dr. Drenyovszki Rajmund Sári Bence	

Course title, code: Economics, GAINBAN-KOZGGAZD-1	**Credits:** 4
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 1+1+0, *semester* 1	
Evaluation type: colloquium	
Recommended semester: 1	
Prerequisites: -	
Subject description: *Course objectives:* The aim of the subject is to introduce the main economic priciples and mechanisms of the market for the students. Both the macro and the micro levels of economics will be taught for the students. The students will learn how the market behavies in different conditions, which are the main incentives of the consumers, how enterprices function and try to increase their profit. *Course contents:* Introduction to economics Introduction to micro economics The market Supply and demand Consumer incentives and decision making The enterprise Production Introduction to macro economics The actors of the market on macro level Economic growth Unemployment Investment Inflation The role of the state Economic development International trade Introduction to economics Introduction to micro economics The market Supply and demand Consumer incentives and decision making The enterprise Production Introduction to macro economics The actors of the market on macro level Economic growth Unemployment Investment Inflation The role of the state Economic development International trade	
Required readings: Ellie Tragakes (2020): Economics. Cambridge University Press. ISBN: 9781108847063	
Acquired competences: *a) knowledge:* *b) skills:* *c) attitude:* - He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas. - He/she makes decisions with full respect for the law and ethical standards in decision-making situations requiring a complex approach. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* *e) additional professional competences:*	
Responsible instructor: Dr. Tóth Ákos	
Instructor(s): Dr. Tóth Ákos	

Course title, code: Mathematics for Computer Science 1, GAINBAN-SZAMMAT1-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+2+0*, semester* 1	
Evaluation type: term mark	
Recommended semester: 1	
Prerequisites: -	
Subject description: *Course objectives:* Introduction to the basic concepts, terminology, theorems and connections of mathematical logic, set theory, combinatorics, and graph theory. *Course contents:* Fundamentals of logic: propositions, equivalence, predicates and quantifiers. Rules of inference and proofs. Sets, cartesian product of sets, correspondences, relations, functions. Equivalence relations and partitions. Permutations. Combinatorics of finite sets. Binomial theorem and multinomial theorem. Mathematical induction. Graphs, trees, basic graph algorithms. Problem solving relating to the lecture syllabus.	
Required readings: R.P. Grimaldi: Discrete and Combinatorial Mathematics: Pearson New International Edition. 5th edition, Pearson, 2013 ISBN: 978-1292035994 E. Lehman, F.T. Leighton, A.R. Meyer: Mathematics for Computer Science. Creative Commons electronic edition, revised 18th May, 2015 http://people.csail.mit.edu/meyer/mcs.pdf K.H. Rosen: Handbook of Discrete and Combinatorial Mathematics. 2nd edition, Chapman and Hall/CRC, Discrete Mathematics and Its Applications Series (Book 8), 2016 ISBN: 978-1584887805	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. *b) skills:* - He/she uses the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of information technology in his/her engineering work for the design of information systems. *c) attitude:* - He/she makes decisions with full respect for the law and ethical standards in decision-making situations requiring a complex approach. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* *e) additional professional competences:* - Efficient use of digital technology, knowledge of digital solutions to fulfill educational objectives	
Responsible instructor: Dobjánné dr. Antal Elvira Mercédesz	
Instructor(s): Dobjánné dr. Antal Elvira Mercédesz Dr. Osztényi József	

Course title, code: Physics, GAINBAN-FIZIKA__-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+2+0*, semester* 1	
Evaluation type: colloquium	
Recommended semester: 1	
Prerequisites: -	
Subject description: *Course objectives:* Comprehensive, almost complete processing of the curriculum of the subject of high school physics, solution of basic physics problems and problems without higher mathematical knowledge, description and mastering of solution methods. Physical foundation of technical expertise. *Course contents:* Physical quantity; measure, unit of measure. The SI system of units. Ratio and level value. Quantities describing the motion of a point of mass. Movement along a line. Plane movements I. Plane movements II. Newton's axioms. Newton's law of gravity. Applications of the basic equation of dynamics I. Applications of the basic equation of dynamics II. Work, energy. Work. Theorem of conservation of mechanical energy. Dynamics of the point system. Internal and external forces. Impulse theorem, center of gravity theorem. Collisions. Hydrostatics. Hydrostatic pressure, the law of Pascal and Archimedes. Changes in the state of ideal gases. Interpretation of pressure based on kinetic gas theory. Absolute temperature concept. Equation of conditions for ideal gases, gas laws. The concept of heat and temperature, temperature scales. Thermal expansion of solids and liquids. Temperature dependence of density. Changes in the state of gases. Heat capacity, specific heat. Acquiring the skills and methods necessary to solve the calculation tasks and practical problems related to the knowledge material discussed at the lecture, practicing them at the skill level.	
Required readings: P. P. Urone, R. Hinrichs: College Physics, OpenStax, Rice University, 2012., ISBN 1-938168-00-3 (web: https://openstax.org/details/books/college-physics) Walker: Fundamentals of Physics, 8th Edition, Wiley, 2007., ISBN 0471758019	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. *b) skills:* *c) attitude:* - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* *e) additional professional competences:*	
Responsible instructor: Dr. Nagy Péter	
Instructor(s): Dr. Lakó Sándor Dezső	

Course title, code: Programming 1, GAINBAN-PROGRAM1-1	**Credits:** 4
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 1	
Evaluation type: term mark	
Recommended semester: 1	
Prerequisites: -	
Subject description: *Course objectives:* The aim of the course Programming 1 is to familiarize students with the basics of the C and C++ programming languages and to enable them to develop simple programs independently. Furthermore, students will learn the steps and basic techniques of software development using the C and C++ languages. *Course contents:* Variables, program structure, programming steps, keywords, operators, logical operations, type conversion, loops, macros, arrays, character arrays, string functions, input-output functions, pointers, indirection, structure, and scope of variables. Variables, program structure, programming steps, keywords, operators, logical operations, type conversion, loops, macros, arrays, character arrays, string functions, input-output functions, pointers, indirection, structure, and scope of variables.	
Required readings: A. Pásztor, Z.C. Johanyák: Basics of the C++ programming language, available in the TEAMS group of the course C++ Programming by Wikibooks, https://upload.wikimedia.org/wikipedia/commons/4/4b/C++_Programming2008-4-18.pdf Stroustrup, Bjarne: The C++ Programming Language (4th Edition), Addison-Wesley, 2013	
Acquired competences: *a) knowledge:* - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. *c) attitude:* - He/she is open to acquire new methods, programming languages and develop skills to use them. *d) autonomy and responsibilities:* *e) additional professional competences:*	
Responsible instructor: Dr. Pásztor Attila	
Instructor(s): Dr. habil Johanyák Zsolt Csaba Dr. Pásztor Attila	

2nd SEMESTER

Course title, code: Algorithms and Data Structures, GAINBAN-ALGOADAT-2	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 2	
Evaluation type: term mark	
Recommended semester: 2	
Prerequisites: -	
Subject description: *Course objectives:* Introduce the most important concepts in the field of algorithms and data structures. At the end of the course, the student should be able to apply the knowledge acquired in solving computer tasks and in software development. *Course contents:* The concept of algorithm. Basic concepts of algorithm analysis and design. Expressing algorithms. Simple algorithms. Sorting algorithms. Search algorithms. Recursiveness, recursive algorithms. Comparison of the efficiency of algorithms. Asymptotic behaviors and notations. Representations of data structures and their operations: queues and stacks, linked lists, stacks, hash tables. Representation of trees, binary search trees and their operations. Representations of graphs, graph theory algorithms. In course of the lab classes the students will learn how to utilize in practice the knowledge acquired during the lessons.	
Required readings: [1] Lee Wittenberg: Data Structures and Algorithms in C++, Pocket Primer, Mercury Learning and Information, 2018, ISBN 9781683920847 [2] Educational materials uploaded by the lecturer to the Internet. [1] Michael McMillan: Data Structures and Algorithms Using C#, Cambridge University Press, 2007, ISBN 0521670152 [2] Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, C. Stein: Introduction to Algorithms, Third Edition, MIT Press Ltd, 2009, ISBN 0262033844 [3] V. Aho, J. E. Hopcroft, J. D. Ullman: Data Structures and Algorithms, Pearson, 1983, ISBN 0201000237. [4] Knuth, D. E.: The Art of Computer Programming I., II. and III. vols., Addison-Wesley, 1997-1998, ISBN 0201853922, 0201896842 and 0201896850	
Acquired competences: *a) knowledge:* - He/she knows the operations of hardware and software elements, the technology of their implementation, how to solve problems related to their operation and the possibilities of the interconnection of IT and other technical systems. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* - He/she uses the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of information technology in his/her engineering work for the design of information systems. He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* - He/she is open to acquire new methods, programming languages and develop skills to use them. He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas. He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* *e) additional professional competences:*	
Responsible instructor: Dr. Alvarez Gil Rafael Pedro	
Instructor(s):	

Course title, code: Calculus 2, GAINBAN-ANALIZI2-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+2+0*, semester* 2	
Evaluation type: colloquium	
Recommended semester: 2	
Prerequisites: Calculus 1	
Subject description: *Course objectives:* The aim of the course is to make the students learn the basic concepts and tools of advanced mathematical analysis that are necessary and required in engineering studies and later on in their profession. *Course contents:* Integral calculus of functions with one variable, methods of determining the indefinite integral. Riemann-Integral, Newton-Leibniz formula, applications: calculating area, surface, volume. Calculus of multivariable functions: partial derivatives, extreme value problems; double integral and its applications. Ordinary differential equations (ODE). Separable ODEs, first order linear ODEs, second order linear ODEs of constant coefficients. Applications of differential equations. Integral calculus of functions with one variable, methods of determining the indefinite integral. Riemann-Integral, Newton-Leibniz formula, applications: calculating area, surface, volume. Calculus of multivariable functions: partial derivatives, extreme value problems; double integral and its applications. Ordinary differential equations (ODE). Separable ODEs, first order linear ODEs, second order linear ODEs of constant coefficients. Applications of differential equations.	
Required readings: George B. Thomas, Maurice D. Weir, Joel Hass, Frank R. Giordano: Thomas' Calculus,Pearson, 2009.	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. *b) skills:* *c) attitude:* - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* *e) additional professional competences:* - Efficient use of digital technology, knowledge of digital solutions to fulfill educational objectives	
Responsible instructor: Dr. Ladics Tamás	
Instructor(s): Dr. Pusztai Béla Gábor	

Course title, code: Computer Architectures 1, GAINBAN-SZAMARC1-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 2	
Evaluation type: colloquium	
Recommended semester: 2	
Prerequisites: Digital Electronics 1	

Subject description:

Course objectives:

The aim of the course is to familiarise students with the operation of computers and peripherals, the main interfaces, with particular emphasis on machine instruction execution and machine data types.

Course contents:

Number systems, conversions (2,8,10,16; whole parts and fractions). Representation of unsigned integers (2,16). Number range for 8, 16, 32, 64 and N bits. MSB, LSB. Representation of signed integers in two's complement code (2, 16). Range of numbers for 8, 16, 32, 64 and N bits. Sign expansion, determining (-1) times of a number, related instructions. Floating point number notation (IEEE-754). The normalized form. Binary representation of the sign ("natural") exponent. Implicit and explicit bit representation. Structure of a number in the 32-bit case. Floating point register/stack organization, operation, RPN formula. Useful floating point constants. BCD number representation (packed, unpacked, tetrad, pseudo-tetrad, half-byte carry). Support for BCD arithmetic at ISA level. Two's complement code addition/subtraction for multi-bit operands. Carry bit, sign bit, overflow bit, zero sign, borrow bit. Main parts of the Neumann machine, their functions. Program area, data area. Stack area. B/K handling. Concept of self modifying code. The Harvard machine. Machine instruction execution flow on the Neumann machine. ILP and pipeline, hazards (WAW, WAR, RAW, RAR) and their handling. Unconditional branching, conditional branching after comparison instruction, conditional branching by state bits, conditional and unconditional procedure call and return, role of stack. Static and dynamic branch prediction, implementation with finite state machine. Vector interrupt system and its operation. Maskable and non-maskable interrupt, software interrupt, interrupt instructions. Interrupt and exception. Structure of machine instructions (four address, three address, two address, 1.5 address, one address, zero address). RISC and CISC. Four address machine and microprogrammed controller. Number of logic functions with N variables. Functionally complete system. Boolean algebra. Algebraic simplification of logic functions. Writing the algebraic form of a logic function given by a truth table, implementation. Logical statements. SRAM and DRAM organization and addressing. Parity protected main memory. Error correction code protected main memory (SECDED ECC). Possibilities of bus design, comparison (TP, OC, TS). Data transfer in synchronous and asynchronous bus, examples. The concept of bus arbitration (decentralised, centralised, priorities). Main parts of the 1-bit ALU (decoder, logic executor, aggregator, inputs, outputs) and schematic circuit diagram. Memory hierarchy (capacity, access time). Principles of cache operation, calculation of average access time, cache organisation methods, operation in read/write. Digital comparator schematic example, caching application. Data storage on moving magnetic media (read/write, organisation, application). Increasing reliability (RAID). HDD and SSD. Possibilities and limitations of increasing computing power. MIPS and FLOPS. Possibilities and limitations to reduce electrical power consumption. From high-level language to HW implementation of machine instructions with examples (levels, languages, virtual machines, interpreter, compiler).

Basic knowledge. Analisys of the IA32 machine instruction execution with Visual Studio Data. Fixed point arithmetic, Logical operations, Stepping, Rotation. Unconditional branching (by flags, after CMP instruction, after TEST instruction), Loops. Stack management, procedure call and return. Other instructions, function given by table, write/read status bits. Tasks and solutions.

Required readings:

A. S. T. Tanenbaum: Structured Computer Organization (6th Edition), Prentice Hall, 2013. ISBN-13: 978-0-13-291652-3

Acquired competences:

a) knowledge:

- He/she knows the operations of hardware and software elements, the technology of their implementation, how to solve problems related to their operation and the possibilities of the interconnection of IT and other technical systems.
- He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level.

b) skills:

- He/she is abile to specify and implement embedded systems using the knowledge gained from his/her studies.

He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology.

- He/she cooperates with other computer science engineers, electrical engineers during team work, and with other experts during the analysis and solution of a problems.
- He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession.

c) attitude:

- He/she genuinely represents the professional principles of engineering and information technology fields.
- He/she aims to see through the entire engineering system not only his/her own field.
- He/she makes an effort to work efficiently and to high standards.

d) autonomy and responsibilities:

- He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team.
- He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them.

e) additional professional competences:

- Efficient use of digital technology, knowledge of digital solutions to fulfill educational objectives

Responsible instructor:
Dr. Pintér István

Instructor(s):
Dr. Drenyovszki Rajmund
Koszna Ferenc

Course title, code: Digital Electronics 2, GAINBAN-DIGTECH2-1	**Credits:** 2
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 0 (credit %), *Practice:* 100 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 0+0+2*, semester* 2	
Evaluation type: colloquium	
Recommended semester: 2	
Prerequisites: Digital Electronics 2	
Subject description: *Course objectives:* The aim of the course is to introduce students to the practical principles and procedures based on the theoretical foundations of digital technology. *Course contents:* The course uses the theoretical knowledge learned in Digital Technology I in laboratory exercises. Simple circuit logic circuits: push-button and signal-to-noise circuits. Combinational circuits using TTL series ICs, push-button input, LED output generation. Logic output with higher current load and inductive load switching via transistor. Construction and testing of simple sequential circuits (storage, counter, shift register, etc.). Simulation of complex combinational/sequential circuits in LabView.	
Required readings: Simon Monk, Programming Arduino: Getting Started with Sketches, McGraw Hill TAB; 2nd edition (June 9, 2016), ISBN-13:978-1259641633	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. *b) skills:* He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* - He/she genuinely represents the professional principles of engineering and information technology fields. - He/she aims to see through the entire engineering system not only his/her own field. - He/she understands and embraces the ethical principles and legal implications of his/her profession. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* - He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team. - He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them. *e) additional professional competences:*	
Responsible instructor: Dr. Kovács Lóránt	
Instructor(s): Sári Bence	

Course title, code: Electricity, GAINBAN-VILLAMOS-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+2+0*, semester* 2	
Evaluation type: colloquium	
Recommended semester: 2	
Prerequisites: -	
Subject description: *Course objectives:* *Course contents:*	
Required readings:	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. - He/she posesses a basic knowledge and engineering approach to signal processing, modelling, simulation and control of systems and networks. *b) skills:* - He/she uses the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of information technology in his/her engineering work for the design of information systems. *c) attitude:* - He/she aims to see through the entire engineering system not only his/her own field. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* *e) additional professional competences:*	
Responsible instructor: Dr. Lakó Sándor Dezső	
Instructor(s):	

Course title, code: English for Computer Science 1, GAINBAN-INFSZAN1-2	**Credits:** 3
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 0 (credit %), *Practice:* 100 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 0+2+0*, semester* 2	
Evaluation type: term mark	
Recommended semester: 2	
Prerequisites: -	
Subject description: *Course objectives:* The aims of the subject Acquisition of the special vocabulary for information technology on an intermediate level. This course combines a specialist vocabulary, and it also develops general language skills which are necessary for the students to succeed in this area. The course contains topics that reflect the latest developments in the field making it immediately relevant to students' needs. The course trains the students for the effective communication at work. *Course contents:* Vocabulary: Types of computers, Computer hardware and peripherals, Latest developments in IT, History of computers, Basic programming vocabulary, Computer networks, Internet marketing, Computer security: viruses, hackers; Extra materials: Impacts modern technology on human life Conversational skills: giving opinion, arguing, polite phrases, and public speaking – giving presentations. Reading skills: application of metacognitive reading strategies, reading different special texts, analysing graphical information Writing skills: writing reports, essays, power point presentations Grammar skills: development of inflectional, derivational and compound morphology Listening: eliciting important information from authentic texts	
Required readings: Eric H. Glendinning, John McEvan (2014). Oxford English forInformationTechnology, Second edition,Oxford University Press, ISBN: 019457492X Noni Rizopoulou (2021). Academic English for Computer Science. Disigma Publications. ISBN: 6185242648	
Acquired competences: *a) knowledge:* - His/her English language skills will be sufficient for the level of training, and to understand English-language literature, to process professional texts, to carry out professional tasks, as well as for continuous professional development. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* - He/she can communicate in Hungarian and in English about professional issues, he/she uses the terms of information technology in a creative way. *c) attitude:* - He/she is open to acquire new methods, programming languages and develop skills to use them. *d) autonomy and responsibilities:* - He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team. *e) additional professional competences:*	
Responsible instructor: Tánczikné Dr. Varga Szilvia	
Instructor(s):	

Course title, code: Introduction to Microprocessor Systems, GAINBAN-MIKRREND-1	**Credits:** 4
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+2+0*, semester* 2	
Evaluation type: term mark	
Recommended semester: 2	
Prerequisites: Digital Electronics 1	
Subject description: *Course objectives:* Review of the main components and structure of the microprocessor, the microcomputer, learning how to execute instructions, addressing solutions and bus system management. *Course contents:* Microcomputers - their structure, operation, time cycles, normal operation and diversion possibilities. Types of memory and their management. Design, operation and instruction set of microprocessors. Examples of microprocessors, CPU designs, instruction set. General characteristics of programmable microprocessor peripherals, example circuits. Embedding memory and I/O elements in memory, I/O. A/D, D/A converters. Types of memory circuits, their applications. Applications of I/O elements, gates. Connecting memories and I/O elements to the CPU bus system. Use of address decoders and control signals. Design based on memory map and I/O map. Analysis of microcomputers. Familiarisation with the instruction set of a simple microprocessor, instruction types. Analysis of instruction execution.	
Required readings: A. S. T. Tanenbaum: Structured Computer Organization (6th Edition), Prentice Hall, 2013. ISBN-13: 978-0-13-291652-3	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. - He/she knows the operations of hardware and software elements, the technology of their implementation, how to solve problems related to their operation and the possibilities of the interconnection of IT and other technical systems. *b) skills:* He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* - He/she genuinely represents the professional principles of engineering and information technology fields. - He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* *e) additional professional competences:*	
Responsible instructor: Dr. Csík Norbert	
Instructor(s): Dr. Drenyovszki Rajmund Sári Bence	

Course title, code: Programming 2, GAINBAN-PROGRAM2-1	**Credits:** 4
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 2	
Evaluation type: term mark	
Recommended semester: 2	
Prerequisites: Programming 1	
Subject description: *Course objectives:* The goal of the course is to deepen students' C++ knowledge acquired during the Programming 1 course, as well as to introduce the concepts and principles of object-oriented programming in C++. *Course contents:* - Recapitulation: arrays, structure, pointers, file IO, functions. - Ref type, parameter passing techniques. - Default function arguments, Vector type. - Introduction to classes and objects. - Basic Principles of OOP (Object-Oriented Programming): Abstraction, Encapsulation, Inheritance, Polymorphism. Access modifiers - Written exam 1 - Inheritance under the loop. - The friend mechanism, class scope. - Written exam 2 - Constructor types. - Replacement/Make-up written exam - Recapitulation: arrays, structure, pointers, file IO, functions. - Ref type, parameter passing techniques. - Default function arguments, Vector type. - Introduction to classes and objects. - Basic Principles of OOP (Object-Oriented Programming): Abstraction, Encapsulation, Inheritance, Polymorphism. Access modifiers - Written exam 1 - Inheritance under the loop. - The friend mechanism, class scope. - Written exam 2 - Constructor types. - Replacement/Make-up written exam	
Required readings: A. Pásztor, Z.C. Johanyák: Basics of the C++ programming language, available in the TEAMS group of the course C++Programming by Wikibooks, https://upload.wikimedia.org/wikipedia/commons/4/4b/C++_Programming2008-4-18.pdf Stroustrup, Bjarne: The C++ Programming Language (4th Edition), Addison-Wesley, 2013	
Acquired competences: *a) knowledge:* - He/she is familiar with the important software development methodologies, and the notation systems for IT designs and documentation. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* - He/she genuinely represents the professional principles of engineering and information technology fields. - He/she is open to acquire new methods, programming languages and develop skills to use them. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* - He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team. *e) additional professional competences:*	
Responsible instructor: Dr. Pásztor Attila	
Instructor(s): Dr. habil Johanyák Zsolt Csaba, Dr. Pásztor Attila	

3rd SEMESTER

Course title, code: Databases, GAINBAN-ADATBAZI-1	**Credits:** 4
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2, *semester* 3	
Evaluation type: colloquium	
Recommended semester: 3	
Prerequisites: -	
Subject description: *Course objectives:* The aim of the course is that students learn the steps and methods of logical and physical design of databases, the possibilities of increasing the efficiency of data storage, the use of the SQL language for the implementation of physical plans and of queries. *Course contents:* Concepts of data modeling. Relational data model. Creating and mapping E-R diagrams to a relational data model. Normalization of relational databases. Relational algebra – set operations, reductions, combinative operations, aggregation, practical examples. Elements of the SQL language: syntax, definition, modification, deletion of special logical expressions, relation schemes. Implementation of queries, sub-queries. Creating and using virtual tables. Constraints, stored procedures, triggers. The role and implementation of data connection layers. Creating and mapping E-R diagrams to a relational data model. Normalization of relational databases. Relational algebra, practical examples. The SQL language: definition, modification and deletion of relational schemas, implementation of queries, relational algebraic operations. Execution of sub-queries, definition of virtual tables.	
Required readings: [1] J. D. Ullman, J. Widom: A First Course in Database Systems. Pearson, 2014. ISBN-13: 978-0136006374. [2] H. Garcia-Molina, J. Ullman, J. Widom: Database Systems: The Complete Book. Pearson, 2011. ISBN: 978-0133002010. [3] M. Gruber: Understanding SQL. SYBEX, US, 1990. ISBN 978-0895886446	
Acquired competences: *a) knowledge:* - His/her English language skills will be sufficient for the level of training, and to understand English-language literature, to process professional texts, to carry out professional tasks, as well as for continuous professional development. - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. - He/she knows the operations of hardware and software elements, the technology of their implementation, how to solve problems related to their operation and the possibilities of the interconnection of IT and other technical systems. - He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security. - He/she has basic data security skills. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* - He/she uses the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of information technology in his/her engineering work for the design of information systems. He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the	

field of information engineering and to process special literature and solve problems related to information technology.
- He/she is able to fulfill analytical, specification, planning, development and operation tasks, in addition, he/she applies the development methodology, debugging, testing and quality assurance methods in his/her field.
- He/she can communicate in Hungarian and in English about professional issues, he/she uses the terms of information technology in a creative way.
- He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession.
c) attitude:
- He/she genuinely represents the professional principles of engineering and information technology fields.
- He/she aims to see through the entire engineering system not only his/her own field.
- He/she is open to acquire new methods, programming languages and develop skills to use them.
- He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas.
- He/she understands and embraces the ethical principles and legal implications of his/her profession.
- He/she makes an effort to work efficiently and to high standards.
- He/she keeps in mind and ensures the security of his/her employees' and customers' data and information.
d) autonomy and responsibilities:
- He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team.
- He/she has a security-conscious attitude in posession of his/her professional knowledge, and is aware of potential threats and opportunities for attack, as well as is prepared to prevent them.
e) additional professional competences:
- Efficient use of digital technology, knowledge of digital solutions to fulfill educational objectives

Responsible instructor:
Dr. Pap-Szigeti Róbert

Instructor(s):
Dr. Pap-Szigeti Róbert

Course title, code: English for Computer Science 2, GAINBAN-INFSZAN2-2	**Credits:** 3
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 0 (credit %), *Practice:* 100 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 0+2+0*, semester* 3	
Evaluation type: term mark	
Recommended semester: 3	
Prerequisites: -	
Subject description: *Course objectives:* Acquisition of the special vocabulary for information technology on an advanced level. This course develops a specialist vocabulary, and it also improves general language skills which are prepares the students for working in an international environment. Besides discussing the latest developments in information technology this course contains topics connected to finding a job in the IT sector, prepares for job interviews, teaches negotiating strategies which enable student to become successful in corporate environment. *Course contents:* Vocabulary: operating systems, programming languages, the internet, networks, computer security, artificial intelligence, robots, programming robots, jobs in information technology, finding a job, IT companies in Hungary and all over the world. Speaking skills: using advanced vocabulary in almost all work related situations Public speaking – develop language skills acceptable for everyday professional use. Reading skills: practising comprehending articles on diverse IT topics analysing non-continuous texts on an advanced level Writing skills: practising advanced writing for different work related purposes Grammar skills: further development of advanced morphological skills Listening: understanding texts on information technology in different English accents	
Required readings: Noni Rizopoulou (2021). Academic English for Computer Science. Disigma Publications. ISBN: 6185242648 Eric H. Glendinning, John McEvan (2014) Oxford English forInformationTechnology, Second edition,Oxford University Press, ISBN: 019457492X	
Acquired competences: *a) knowledge:* - His/her English language skills will be sufficient for the level of training, and to understand English-language literature, to process professional texts, to carry out professional tasks, as well as for continuous professional development. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* - He/she can communicate in Hungarian and in English about professional issues, he/she uses the terms of information technology in a creative way. *c) attitude:* - He/she is open to acquire new methods, programming languages and develop skills to use them. *d) autonomy and responsibilities:* - He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team. *e) additional professional competences:*	
Responsible instructor: Tánczikné Dr. Varga Szilvia	
Instructor(s):	

Course title, code: Management, GAINBAN-MENEDZSM-1	**Credits:** 4
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 67 (credit %), *Practice:* 33 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+1+0*, semester* 3	
Evaluation type: colloquium	
Recommended semester: 3	
Prerequisites: -	
Subject description: *Course objectives:* The students should get to know the characteristics and relationships of the operation of market organizations. Know the groups of internal and external factors affecting corporate performance, the structure of organizations, and the main strategies. *Course contents:* Introduction to management. The concept of management. Managers and/or leaders. Managerial roles. The manager's relationship system. The group and the organization. General structural, functional, and dynamic characteristics of organizations. Classical principles and human relations in management. Basic issues of managing organizational processes. Modern theories of management. The organizational environment and organizational characteristics. Organizational culture. Decision-making in organizations. Change management. Organizational forms in management Strategy in organizations. (Summary, exam information.) During the exercises, the knowledge presented at the lecture is processed together.	
Required readings: G. A. Cole , Phil Kelly: Management Theory and Practice, Cengage Learning EMEA, 2020, ISBN 978-1473769724 Stephen P. Robbins, Mary A. Coulter: Management (5th Edition) Global Edition Prentice Hall, 2012, ISBN 9781292340883	
Acquired competences: *a) knowledge:* *b) skills:* - He/she cooperates with other computer science engineers, electrical engineers during team work, and with other experts during the analysis and solution of a problems. *c) attitude:* - He/she makes decisions with full respect for the law and ethical standards in decision-making situations requiring a complex approach. *d) autonomy and responsibilities:* *e) additional professional competences:* - Basic knowledge about promoting health and sustainable development which include the basics of environment, work safety and consumer protection	
Responsible instructor: Dr. Huff Endre	
Instructor(s): Dr. Csendes István	

Course title, code: Operating Systems, GAINBAN-OPERREND-1	**Credits:** 4
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 3	
Evaluation type: colloquium	
Recommended semester: 3	
Prerequisites: Computer Architectures 1	
Subject description: *Course objectives:* *Course contents:*	
Required readings:	
Acquired competences: *a) knowledge:* - He/she knows the operations of hardware and software elements, the technology of their implementation, how to solve problems related to their operation and the possibilities of the interconnection of IT and other technical systems. - He/she has basic data security skills. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she is able to fulfill analytical, specification, planning, development and operation tasks, in addition, he/she applies the development methodology, debugging, testing and quality assurance methods in his/her field. - He/she can communicate in Hungarian and in English about professional issues, he/she uses the terms of information technology in a creative way. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* - He/she genuinely represents the professional principles of engineering and information technology fields. - He/she is open to acquire new methods, programming languages and develop skills to use them. - He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas. *d) autonomy and responsibilities:* - He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team. - He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them. *e) additional professional competences:*	
Responsible instructor: Dr. Megyesi Zoltán	
Instructor(s):	

Course title, code: Probability and Statistics, GAINBAN-VALOSTAT-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+2+0*, semester* 3	
Evaluation type: term mark	
Recommended semester: 3	
Prerequisites: Calculus 1	
Subject description: *Course objectives:* The course is an introduction to Probability and Statistics. The topics covered include Descriptive Statistics, Probability and Inferential Statistics. The aim of the course is to introduce the notions, methods an the necassary theoretical background related to Data Analysis and Probability with applications in Engineering. *Course contents:* Descriptive Statistics,Measures of Location, Variability and Shape, Mathematical Model of Random Experiments, Relative frequency, Events and Probability, Kolmogorov axioms, Classical Probability Model, Conditional Probability, Independence, Discrete Random Variables, Expected Value and Variance, Binomial, Hypergeometric and Poisson Distribution, Continuous Random Variables, Uniform, Exponential and Normal Distribution, De Moivre-Laplace Theorem, Central Limit Theorem, SAmpling Distributions, Point and Interval Estmation, Hypothesis Testing, Analysing bivariate Data, Khi-square Test for Independence, Correlation, Regression Descriptive Statistics,Measures of Location, Variability and Shape, Mathematical Model of Random Experiments, Relative frequency, Events and Probability, Kolmogorov axioms, Classical Probability Model, Conditional Probability, Independence, Discrete Random Variables, Expected Value and Variance, Binomial, Hypergeometric and Poisson Distribution, Continuous Random Variables, Uniform, Exponential and Normal Distribution, De Moivre-Laplace Theorem, Central Limit Theorem, SAmpling Distributions, Point and Interval Estmation, Hypothesis Testing, Analysing bivariate Data, Khi-square Test for Independence, Correlation, Regression	
Required readings: Materials uploaded to TEAMS.	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. *b) skills:* *c) attitude:* - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* *e) additional professional competences:* - Efficient use of digital technology, knowledge of digital solutions to fulfill educational objectives	
Responsible instructor: Oszténayiné dr. Krauczi Éva	
Instructor(s): Kelecsényi Klára	

Course title, code: Programming Paradigms and Techniques, GAINBAN-PROPARTE-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 3	
Evaluation type: term mark	
Recommended semester: 3	
Prerequisites: Programming 1 + Algorithms and Data Structures	
Subject description: *Course objectives:* The aim of this course is to introduce the most important principles of the object oriented programming through specific examples written in .NET/C#. Besides, the students get knowledge about the programming tools most frequently used in C#. *Course contents:* The Visual Studio IDE and the console application template. The console input/output tools of the C# language. Basic data types and variables. Objects: classes and instances. Members: variables and methods. The role of the constructor and instantiating. Access levels: public and private members. Static members and their usage. Dynamic arrays. Mathematical tools in C#. Strings and string manipulation. The enum type. File input/output tools in C#. Inheritance, and the protected access level. Overriding virtual functions, abstract functions and abstract classes. Interfaces and their implementation. Polymorphism. Generic classes and methods. Generic list and dictionaries. Reference and value types, the copy-constructor. The Visual Studio IDE and the console application template. The console input/output tools of the C# language. Basic data types and variables. Objects: classes and instances. Members: variables and methods. The role of the constructor and instantiating. Access levels: public and private members. Static members and their usage. Dynamic arrays. Mathematical tools in C#. Strings and string manipulation. The enum type. File input/output tools in C#. Inheritance, and the protected access level. Overriding virtual functions, abstract functions and abstract classes. Interfaces and their implementation. Polymorphism. Generic classes and methods. Generic list and dictionaries. Reference and value types, the copy-constructor.	
Required readings: John Sharp, Microsoft Visual C# Step by Step (9th Edition), Microsoft Press, 2018. Troelsen and P. Japikse, Pro C# 7: With .NET and .NET Core. Berkeley, CA: Apress, 2017. M. Seidl, M. Scholz, C. Huemer, and G. Kappel, UML @ classroom an introduction to object-oriented modelling. Cham: Springer, 2015. Any written or online literature related to C # and UML.	
Acquired competences: *a) knowledge:* - He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security. - He/she is familiar with the important software development methodologies, and the notation systems for IT designs and documentation. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:*	

- He/she genuinely represents the professional principles of engineering and information technology fields. - He/she is open to acquire new methods, programming languages and develop skills to use them. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* - He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team. *e) additional professional competences:*
Responsible instructor: Dr. Kovács Tamás
Instructor(s): Dr. Katona József

Course title, code: Signals and Systems, GAINBAN-JELEKREN-1	**Credits:** 4
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+2+0*, semester* 3	
Evaluation type: colloquium	
Recommended semester: 3	
Prerequisites: Electricity + Physics	
Subject description: *Course objectives:* Analysis of AC networks; understanding signal propagation, analogue and digital filters, application of digital signal processing methods, deterministic and stochastic signals in spectral- and time domain, introduction to basic systems theory. *Course contents:* The aim of teaching the subject: Introduction to the characteristics of AC networks, analysis, signal propagation, analogue and digital filters, familiar digital signal processing methods, spectral and time domain behaviour of deterministic and stochastic signals, introduction to basic systems theory and measurement techniques. The aim of teaching the subject: Introduction to the characteristics of AC networks, analysis, signal propagation, analogue and digital filters, familiar digital signal processing methods, spectral and time domain behaviour of deterministic and stochastic signals, introduction to basic systems theory and measurement techniques.	
Required readings:	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. - He/she posesses a basic knowledge and engineering approach to signal processing, modelling, simulation and control of systems and networks. *b) skills:* - He/she uses the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of information technology in his/her engineering work for the design of information systems. He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she cooperates with other computer science engineers, electrical engineers during team work, and with other experts during the analysis and solution of a problems. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* - He/she genuinely represents the professional principles of engineering and information technology fields. - He/she aims to see through the entire engineering system not only his/her own field. - He/she is open to acquire new methods, programming languages and develop skills to use them. - He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas. *d) autonomy and responsibilities:* *e) additional professional competences:* - Efficient use of digital technology, knowledge of digital solutions to fulfill educational objectives	
Responsible instructor: Dr. Csík Norbert	
Instructor(s): Dr. Csík Norbert	

Course title, code: Soft Skillls, GAINBAN-TRANSZIS-1	**Credits:** 1
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 0 (credit %), *Practice:* 100 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 0+1+0*, semester* 3	
Evaluation type: term mark	
Recommended semester: 3	
Prerequisites: -	
Subject description: *Course objectives:* Developing of knowledge, abilities, skills and competencies necessary for effective participation in the university education process and the successful practice of the profession. *Course contents:* Self-awareness, communication techniques, presentation techniques, teamwork, basics of project management, job search methods, creating a resume, preparing for a job interview	
Required readings: [1] Barbara Oakley: Learning to Learn. Oakland University, Rochester, MI 48309. https://www.oakland.edu/Assets/upload/docs/UG-Education/Retention_Conference/Retention_Presenations/2014_Ret_Conf_Presentations/03_Learn_to_Learn.pdf	
Acquired competences: *a) knowledge:* *b) skills:* - He/she cooperates with other computer science engineers, electrical engineers during team work, and with other experts during the analysis and solution of a problems. *c) attitude:* - He/she makes decisions with full respect for the law and ethical standards in decision-making situations requiring a complex approach. - He/she understands and embraces the ethical principles and legal implications of his/her profession. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* - He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team. *e) additional professional competences:* - Knowledge of the labour market consequences of structural changes of digitalisation and automation in production, supply chain, and in the organisation of production processes	
Responsible instructor: Dr. Pap-Szigeti Róbert	
Instructor(s):	

4th SEMESTER

Course title, code: Database Systems, GAINBAN-ADATBARE-2	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 4	
Evaluation type: term mark	
Recommended semester: 4	
Prerequisites: Databases + Programming 1	
Subject description: *Course objectives:* The aim of the course is a deeper understanding of principles of the database systems; implementing these principles in the process of solving database problems; understanding the analysis and optimization of the background processes of database systems. *Course contents:* A review of the SQL language. SQL as a plug-in language (cursors, cycles). Stored procedures, functions, triggers. Data storage, representation of data elements and indexes. Execution mechanism of queries, cost estimation. Transactions, locks. Transaction management - schedules, histories. Data warehouses, OLAP applications. Data mining. A review of the SQL language. Basic knowledge of Informix DBMS. Calculated and conditional fields in Informix. Connecting to the Oracle Server with the Oracle SQL Developer environment. Implementation of cursors and cycles in PL/SQL. Implementing stored procedures and functions. Making packages, error handling. Implementing triggers. Query plans, cost estimate. Transaction management in practice.	
Required readings: [1] J. D. Ullman, J. Widom: A First Course in Database Systems. Pearson, 2014. ISBN-13: 978-0136006374. [1] H. Garcia-Molina, J. Ullman, J. Widom: Database Systems: The Complete Book. Pearson, 2011. ISBN: 978-0133002010. [2] M. Gruber: Understanding SQL. SYBEX, US, 1990. ISBN 978-0895886446	
Acquired competences: *a) knowledge:* - His/her English language skills will be sufficient for the level of training, and to understand English-language literature, to process professional texts, to carry out professional tasks, as well as for continuous professional development. - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. - He/she knows the operations of hardware and software elements, the technology of their implementation, how to solve problems related to their operation and the possibilities of the interconnection of IT and other technical systems. - He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security. - He/she has basic data security skills. *b) skills:* - He/she uses the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of information technology in his/her engineering work for the design of information systems. He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she is able to fulfill analytical, specification, planning, development and operation tasks, in addition, he/she applies the development methodology, debugging, testing and quality assurance methods in his/her	

field.
- He/she can communicate in Hungarian and in English about professional issues, he/she uses the terms of information technology in a creative way.
- He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession.

c) attitude:
- He/she genuinely represents the professional principles of engineering and information technology fields.
- He/she aims to see through the entire engineering system not only his/her own field.
- He/she is open to acquire new methods, programming languages and develop skills to use them.
- He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas.
- He/she understands and embraces the ethical principles and legal implications of his/her profession.
- He/she makes an effort to work efficiently and to high standards.
- He/she keeps in mind and ensures the security of his/her employees' and customers' data and information.

d) autonomy and responsibilities:
- He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team.
- He/she has a security-conscious attitude in posession of his/her professional knowledge, and is aware of potential threats and opportunities for attack, as well as is prepared to prevent them.

e) additional professional competences:
- Efficient use of digital technology, knowledge of digital solutions to fulfill educational objectives

Responsible instructor:
Dr. Pap-Szigeti Róbert

Instructor(s):
Dr. Pap-Szigeti Róbert

Course title, code: Enterpise Resource Planning Systems 1, GAINBAN-VAINFRE1-1	**Credits:** 4
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+2+0*, semester* 4	
Evaluation type: term mark	
Recommended semester: 4	
Prerequisites: Databases	
Subject description: *Course objectives:* Students get acquainted with the purpose, functions and structure of ERP systems. They acquire basic skills in resource planning. *Course contents:* The role of information in the operation of an enterprise. The purpose of ERP systems. Typical ERP modules. Enterprise modelling: representation of goals, structure, activities, processes, resources. Resource management, decision support systems. Online Transaction Processing (OLTP) vs. Online Analytical Processing (OLAP). Project management, workflow systems. Formulation of resource planning problems, and their solution using Excel Solver. Transportation and location problems. Stockpile management. Production scheduling and assembly line balancing.	
Required readings: E.F. Monk, B.J. Wagner: Concepts in Enterprise Resource Planning. Cengage Learning, 2013. ISBN-13: 978-1-111-82039-8. K.C. Laudon, J.P. Laudon: Management Information Systems: Managing the Digital Firm. Prentice Hall, 2012 / Pearson 2019. ISBN-13: 9780135790939.	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. *b) skills:* - He/she uses the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of information technology in his/her engineering work for the design of information systems. - He/she is able to develop enterprise information systems and implement previous developments. He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she cooperates with other computer science engineers, electrical engineers during team work, and with other experts during the analysis and solution of a problems. *c) attitude:* - He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas. *d) autonomy and responsibilities:* - He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them. *e) additional professional competences:* - Efficient use of digital technology, knowledge of digital solutions to fulfill educational objectives	
Responsible instructor: Prof. Dr. Fábián Csaba István	
Instructor(s): Prof. Dr. Fábián Csaba István	

Course title, code: Introduction to Information System Security, GAINBAN-INFBIZAL-1	**Credits:** 3
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+2+0*, semester* 4	
Evaluation type: colloquium	
Recommended semester: 4	
Prerequisites: Mathematics for Computer Science II + Database Systems	
Subject description: *Course objectives:* *Course contents:*	
Required readings:	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. - He/she knows the operations of hardware and software elements, the technology of their implementation, how to solve problems related to their operation and the possibilities of the interconnection of IT and other technical systems. - He/she posesses a basic knowledge and engineering approach to signal processing, modelling, simulation and control of systems and networks. - He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security. - He/she is familiar with the important software development methodologies, and the notation systems for IT designs and documentation. - He/she has basic data security skills. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* - He/she uses the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of information technology in his/her engineering work for the design of information systems. - Using the knowledge gained from his/her studies, he/she will be able to install and configure computer and telecommunications networks, troubleshoot network faults, operate and upgrade networks. - He/she is able to develop enterprise information systems and implement previous developments. He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she is able to fulfill analytical, specification, planning, development and operation tasks, in addition, he/she applies the development methodology, debugging, testing and quality assurance methods in his/her field. - He/she cooperates with other computer science engineers, electrical engineers during team work, and with other experts during the analysis and solution of a problems. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* - He/she genuinely represents the professional principles of engineering and information technology fields. - He/she aims to see through the entire engineering system not only his/her own field.	

- He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas.
- He/she makes decisions with full respect for the law and ethical standards in decision-making situations requiring a complex approach.
- He/she understands and embraces the ethical principles and legal implications of his/her profession.
- He/she makes an effort to work efficiently and to high standards.
- He/she keeps in mind and ensures the security of his/her employees' and customers' data and information.

d) autonomy and responsibilities:

- He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them.
- He/she has a security-conscious attitude in posession of his/her professional knowledge, and is aware of potential threats and opportunities for attack, as well as is prepared to prevent them.

e) additional professional competences:

Responsible instructor:
Dr. Kovács Tamás

Instructor(s):

Course title, code: Linear Control Systems, GAINBAN-IRANYTEC-1	**Credits:** 4
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+2+0*, semester* 4	
Evaluation type: colloquium	
Recommended semester: 4	
Prerequisites: Signals and Systems	
Subject description: *Course objectives:* *Course contents:*	
Required readings:	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. - He/she posesses a basic knowledge and engineering approach to signal processing, modelling, simulation and control of systems and networks. *b) skills:* He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* - He/she genuinely represents the professional principles of engineering and information technology fields. - He/she aims to see through the entire engineering system not only his/her own field. - He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas. - He/she understands and embraces the ethical principles and legal implications of his/her profession. - He/she makes an effort to work efficiently and to high standards. - He/she keeps in mind and ensures the security of his/her employees' and customers' data and information. *d) autonomy and responsibilities:* - He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team. - He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them. *e) additional professional competences:*	
Responsible instructor: Dr. Kovács Lóránt	
Instructor(s):	

Course title, code: Mathematics for Computer Science 2, GAINBAN-SZAMMAT2-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 0 (credit %), *Practice:* 100 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 0+2+2*, semester* 4	
Evaluation type: colloquium	
Recommended semester: 4	
Prerequisites: Mathematics for Computer Science I	
Subject description: *Course objectives:* Introduction to the basic concepts, terminology, theorems, and application of number theory, abstract algebra, cryptography, codes. *Course contents:* Introduction to number theory. Fundamental theorem of arithmetic. Diophantine equations. Congruences, residue classes. Solvability of linear congruences. Euclidean algorithm. Fermat's little theorem, Fermat-Euler theorem. Basics of cryptography, public key encryption, RSA algorithm. Prime numbers, prime testing. Basic concepts of abstract algebra. Subgroup, Lagrange theorem. Permutation groups. Direct product, Abel groups. Rings, fields, finite fields. Polynomials, irreducible polynomials. Polynomials over a finite field, finite field of prime order. Basic coding concepts, error correcting codes. Binary linear and Hamming codes. Linear codes, Hamming codes. Reed-Solomon codes, cyclic codes, BCH codes. Solving practical problems and exercises related to the knowledge acquired in the seminars using MATLAB.	
Required readings: Mark Kelbert, Yuri Suhov, Information Theory and Coding by Example, Cambridge University Press , 2013, ISBN:9780521139885	
Acquired competences: *a) knowledge:* - Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT. *b) skills:* - He/she uses the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of information technology in his/her engineering work for the design of information systems. *c) attitude:* - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* *e) additional professional competences:* - Efficient use of digital technology, knowledge of digital solutions to fulfill educational objectives	
Responsible instructor: Dr. Végh Attila	
Instructor(s): Dr. Végh Attila	

Course title, code: Visual Programming, GAINBAN-VIZUPROG-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 4	
Evaluation type: term mark	
Recommended semester: 4	
Prerequisites: Programming Paradigms and Techniques	
Subject description: *Course objectives:* *Course contents:*	
Required readings:	
Acquired competences: *a) knowledge:* - He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security. - He/she is familiar with the important software development methodologies, and the notation systems for IT designs and documentation. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* - He/she is able to develop applications, program client-server and WEB, mobile operating systems, develop multiplatform systems. He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she is able to fulfill analytical, specification, planning, development and operation tasks, in addition, he/she applies the development methodology, debugging, testing and quality assurance methods in his/her field. - He/she cooperates with other computer science engineers, electrical engineers during team work, and with other experts during the analysis and solution of a problems. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* - He/she genuinely represents the professional principles of engineering and information technology fields. - He/she aims to see through the entire engineering system not only his/her own field. - He/she is open to acquire new methods, programming languages and develop skills to use them. - He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* - He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team. - He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them.	
Responsible instructor: Dr. habil Johanyák Zsolt Csaba	
Instructor(s): Dr. habil Johanyák Zsolt Csaba Dr. Subecz Zoltán	

Course title, code: Web Programming 1, GAINBAN-WEBPROG1-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 4	
Evaluation type: term mark	
Recommended semester: 4	
Prerequisites: Programming 1	

Subject description:

Course objectives:

The aims of the course are the introduction of the standards, methods and tools of the web pages development, as well as the client side and the server side web programming.

Course contents:

The relationship between the website and the visitor. How the network works. Creation of the development environment. HTML basics. CSS basics. Web server configuration. PHP basics. Database management in PHP.. The front controller design pattern. JavaScript basics. Introduction to object-oriented programming in JavaScript. JSON. Introduction to AJAX. JavaScript Libraries, presentation of a selected library. What's new in HTML5.

In course of the lab classes the students will learn how to utilize in practice the knowledge acquired during the lessons.

Required readings:

[1] Robin Nixon: Learning PHP, MySQL, JavaScript, CSS & HTML5, Third Edition, O'Reilly Media, 2014, ISBN 9781491949467. [2] V. DeBolt: Mastering Integrated HTML and CSS, Wiley Publishing, 2007, ISBN: 978-0-470-09754-0

[1] Josh Lockhart: Modern PHP: New Features and Good Practices, O'Reilly Media, 2015, ISBN 9781491905012. [2] https://www.w3schools.com/html/ [3] https://www.w3schools.com/css/ [4] https://www.w3schools.com/js/ [5] https://learn.jquery.com/ [6] https://www.w3schools.com/php/ [7] https://www.w3schools.com/js/js_ajax_intro.asp

Acquired competences:

a) knowledge:

- He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security.
- He/she is familiar with the important software development methodologies, and the notation systems for IT designs and documentation.
- He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level.

b) skills:

- He/she is able to develop applications, program client-server and WEB, mobile operating systems, develop multiplatform systems.

He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology.

- He/she cooperates with other computer science engineers, electrical engineers during team work, and with other experts during the analysis and solution of a problems.
- He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession.

c) attitude:

- He/she is open to acquire new methods, programming languages and develop skills to use them.
- He/she makes an effort to work efficiently and to high standards.

d) autonomy and responsibilities: - He/she has a security-conscious attitude in posession of his/her professional knowledge, and is aware of potential threats and opportunities for attack, as well as is prepared to prevent them. *e) additional professional competences:*
Responsible instructor: Dr. Alvarez Gil Rafael Pedro
Instructor(s):

5th SEMESTER

Course title, code: Advanced Programming Techniques, GAINBAN-HALAPROG-1	**Credits:** 4
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 5	
Evaluation type: term mark	
Recommended semester: 5	
Prerequisites: 100 kredit + Programming Paradigms and Techniques	
Subject description: *Course objectives:* Students will learn about the Python language and its applications in machine learning and data processing. *Course contents:* Applications of Python. Python data structures, list comprehension, dict comprehension. Mathematical calculations and data structures (NumPy), visualization (Matplotlib). Object oriented programming in Python. Exception handling. Python Standard Library. Optimization with open source Python based tools. Machine learning basics. Neural Networks and Deep Learning. Using the interpreter. Variables, types. String and file handling. Data structures (list, dictionary, set, etc.) and their handling through practical examples. Functions and their use. Optimization with open source Python based tools. Clustering. Classification. Project assignment.	
Required readings: [1] Richard L. Halterman: Fundamentals of Python Programming, 2017, https://python.cs.southern.edu/pythonbook/pythonbook.pdf [2] Andriy Burkov: The hundred-page machine learning book, http://themlbook.com/	
Acquired competences: *a) knowledge:* - He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security. - He/she is familiar with the important software development methodologies, and the notation systems for IT designs and documentation. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* - He/she is able to develop applications, program client-server and WEB, mobile operating systems, develop multiplatform systems. He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she is able to fulfill analytical, specification, planning, development and operation tasks, in addition, he/she applies the development methodology, debugging, testing and quality assurance methods in his/her field. - He/she cooperates with other computer science engineers, electrical engineers during team work, and with other experts during the analysis and solution of a problems. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession.	
Responsible instructor: Dr. Drenyovszki Rajmund	
Instructor(s): Dr. Drenyovszki Rajmund Gurka Dezsőné Csizmás Edit	

Course title, code: Cloud based Services, GAINBAN-FELHALSZ-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 5	
Evaluation type: term mark	
Recommended semester: 5	
Prerequisites: 100 cr	

Subject description:

Course objectives:

The students should learn the purpose and basic concepts of cloud-based services, and by getting to know a specific tool, they should be able to create basic and, in the case of certain elements, advanced services.

Course contents:

Overview of the infrastructure of the world's largest cloud provider (Amazon Web Service - AWS). Cloud-based systems - basic concepts, standards. Safety principles and rules. Default network operation, virtual private networks (VPC). Creation and management of user identities (IAM). Virtual machines and capacities (EC2). Disk images, snapshots, distributed data storage and serving (S3, EBS). Load distribution, caches (ELB, CloudFormation). Relational and key-value databases (RDS, NoSQL). Operation and monitoring (CloudWatch, SNS). Queues (SQS). Infrastructure automatic scalability (ASG).

Amazon Web Service console and command line. Creating a virtual private network. User access and authorization settings, implementation of key-based identification. Creating, stopping and copying a virtual server. Creating a distributed database, setting up access. Organization and design of load distribution. Create a database. Monitoring and alarm setting. Sizing, infrastructure scalability. Component integration exercise.

Required readings:

[1] Bálint Farkas, Gábor Kovács, István Király, Attila Turóczy, Tibor Kőnig, Attila Érsek, Mátyás Safranka, Dávid Fülöp, Krisztián Pellek, Balázs Kiss: Windows Azure step by step, JEDLIK EDUCATIONAL STUDIO, Budapest, 2013, ISBN: 978 -615-5012-21-1[2] Cloud Computing: Principles and Paradigms (Rajkumar Buyya, James Broberg, Andrzej M. Goscinski)

[1] Amazon Web Service – Getting Started / User Guides (minden szolgáltatáshoz) E-bookshttp://www.amazon.com/Amazon-Web-Services/e/B007R6MVQ6/ref=dp_byline_cont_ebooks_1

Acquired competences:

a) knowledge:

- His/her English language skills will be sufficient for the level of training, and to understand English-language literature, to process professional texts, to carry out professional tasks, as well as for continuous professional development.
- Knowledge of the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of IT.
- He/she knows the operations of hardware and software elements, the technology of their implementation, how to solve problems related to their operation and the possibilities of the interconnection of IT and other technical systems.
- He/she posesses a basic knowledge and engineering approach to signal processing, modelling, simulation and control of systems and networks.
- He/she is familiar with the important software development methodologies, and the notation systems for IT designs and documentation.
- He/she has basic data security skills.
- He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level.

b) skills:

- He/she uses the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of information technology in his/her engineering work for the design of information systems.

- Using the knowledge gained from his/her studies, he/she will be able to install and configure computer and telecommunications networks, troubleshoot network faults, operate and upgrade networks.
- He/she is able to develop applications, program client-server and WEB, mobile operating systems, develop multiplatform systems.
- He/she is able to develop enterprise information systems and implement previous developments.
- He/she is abile to specify and implement embedded systems using the knowledge gained from his/her studies.
He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology.
- He/she is able to fulfill analytical, specification, planning, development and operation tasks, in addition, he/she applies the development methodology, debugging, testing and quality assurance methods in his/her field.
- He/she cooperates with other computer science engineers, electrical engineers during team work, and with other experts during the analysis and solution of a problems.
- He/she can communicate in Hungarian and in English about professional issues, he/she uses the terms of information technology in a creative way.
- He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession.

c) attitude:

- He/she genuinely represents the professional principles of engineering and information technology fields.
- He/she aims to see through the entire engineering system not only his/her own field.
- He/she is open to acquire new methods, programming languages and develop skills to use them.
- He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas.
- He/she makes decisions with full respect for the law and ethical standards in decision-making situations requiring a complex approach.
- He/she understands and embraces the ethical principles and legal implications of his/her profession.
- He/she makes an effort to work efficiently and to high standards.
- He/she keeps in mind and ensures the security of his/her employees' and customers' data and information.

d) autonomy and responsibilities:

- He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team.
- He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them.
- He/she has a security-conscious attitude in posession of his/her professional knowledge, and is aware of potential threats and opportunities for attack, as well as is prepared to prevent them.

e) additional professional competences:

Responsible instructor:
Dr. Kovács Tamás

Instructor(s):
Cserkó József

Course title, code: Developing Mobile Applications 1, GAINBAN-FEJLMOE1-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2, *semester* 5	
Evaluation type: term mark	
Recommended semester: 5	
Prerequisites: 100 cr	
Subject description: *Course objectives:* The aim of this course is to introduce the basics of application development for the Apple iOS platform using Swift programming language. *Course contents:* Course content - lectures: Introduction to iOS: history, iOS architecture, development languages, frameworks. Introduction to development tool, XCode, emulator. Objective-C and swift programming basics. iOS project architecture. Application lifecycle. Creating UI controls, layouts. Design and animation. MVC in iOS. Persistent data storage. iOS networking, calling REST services. Course content - labs: Creating user interface, introduce UI controls. Demonstrate the application lifecycle model. Using Modell-View-Controller pattern. Creating a list-detailed view. Implementing calling REST API endpoints. *Mid-term study requirements:* Attending classes, reviewing and supplementing what you have heard at home based on the literature recommended in class. Theoretical and lab exams.	
Required readings: [1] Start Developing iOS Apps (Swift) https://developer.apple.com/library/archive/referencelibrary/GettingStarted/DevelopiOSAppsSwift/ [2] M. Neuburg: iOS 12 Programming Fundamentals with Swift: Swift, Xcode, and Cocoa Basics, 1st edition, O'Reilly Media, 2018, ISBN-10: 1492044555, ISBN-13: 978-1492044550	
Acquired competences: *Knowledge:* - Ability to develop applications, client-server and WEB, mobile systems, multiplatform systems. - Ability to build on the basic knowledge acquired to acquire in-depth knowledge of a technical IT area, to work through the literature and to solve IT problems related to the area. - Communicate in English and Hungarian on technical issues and use the formal language of informatics in a creative way. - Continuously educate and keep abreast of developments in the IT profession. *Skills:* - Familiar with the main programming paradigms, programming languages and development tools. Knowledge includes information systems modelling, database systems design, computer network design, operation and implementation, intelligent systems features, mobile application development, modern general purpose operating systems management and IT security aspects - Knowledge of important software development methodologies, notation systems for IT designs and documentation. - Knowledge of IT and engineering vocabulary and terminology in Hungarian and English, at least at a basic level. *Attitude:* - It represents the professional principles of engineering and information technology in a credible manner. -Ability to learn new methods, programming languages and procedures and to master them at a proficiency level - Strives to work efficiently and to a high standard of quality. *Autonomy and responsibilities:*	

- Identify the shortcomings of the technologies used, the risks of the processes and initiate measures to reduce them. - With this knowledge, he/she has a security-conscious attitude, is aware of potential threats and opportunities for attack and is prepared to counter them. *Additional professional competences:*
Responsible instructor: Dr. Bolla Kálmán Milán
Instructor(s): Dr. Bolla Kálmán Milán

Course title, code: Introduction to Artificial Intelligence, GAINBAN-MESTINAL-2	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 5	
Evaluation type: term mark	
Recommended semester: 5	
Prerequisites: 100 cr	
Subject description: *Course objectives:* *Course contents:*	
Required readings:	
Acquired competences: *a) knowledge:* - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* *d) autonomy and responsibilities:* - He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team. *e) additional professional competences:*	
Responsible instructor: Dr. Pásztor Attila	
Instructor(s):	

Course title, code: Java Applications, GAINBAN-JAVAALKA-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 5	
Evaluation type: term mark	
Recommended semester: 5	
Prerequisites: Programming Paradigms and Techniques + 100 cr	
Subject description: *Course objectives:* Getting to know the Java programming language, the Java Spring framework, learning to use a modern development environment (IntelliJ, NetBeans, Eclipse). *Course contents:* Java basics, loops, types, methods, file management, Array, List, Map, Set. Object oriented programming. JDBC. Server-side programming, Java Spring, Java Spring Boot, MVC, Thymeleaf template engine, Forms, Validation, Java Persistence API, Hibernate, ORM, Annotations, Spring Boot Security, Authentication and Authorization, RESTful API, Dependency injection, CRUD operations. Lambda expressions, Streams, thread management. Swing Graphic application development with JavaFX. Java basics, loops, types, methods, file management, Array, List, Map, Set. Object oriented programming. JDBC. Server-side programming, Java Spring, Java Spring Boot, MVC, Thymeleaf template engine, Forms, Validation, Java Persistence API, Hibernate, ORM, Annotations, Spring Boot Security, Authentication and Authorization, RESTful API, Dependency injection, CRUD operations.	
Required readings: Brett Spell: Pro Java 8 Programming, Third Edition, Apress., 2015, ISBN 9781484206416 Craig Walls and Ryan Breidenbach: Spring in Action 5th Edition, 2018, Amazon.com Services LLC, ISBN: 978-1617294945	
Acquired competences: *a) knowledge:* - He/she knows the operations of hardware and software elements, the technology of their implementation, how to solve problems related to their operation and the possibilities of the interconnection of IT and other technical systems. - He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security. - He/she is familiar with the important software development methodologies, and the notation systems for IT designs and documentation. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* - He/she is able to develop applications, program client-server and WEB, mobile operating systems, develop multiplatform systems. He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* - He/she is open to acquire new methods, programming languages and develop skills to use them. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:*	

- He/she has a security-conscious attitude in posession of his/her professional knowledge, and is aware of potential threats and opportunities for attack, as well as is prepared to prevent them. *e) additional professional competences:*
Responsible instructor: Dr. Subecz Zoltán
Instructor(s):

Course title, code: Server Side Applications, GAINBAN-SZERVALK-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 5	
Evaluation type: term mark	
Recommended semester: 5	
Prerequisites: 100 cr	
Subject description: *Course objectives:* *Course contents:*	
Required readings:	
Acquired competences: *a) knowledge:* - He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security. - He/she is familiar with the important software development methodologies, and the notation systems for IT designs and documentation. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* - He/she is able to develop applications, program client-server and WEB, mobile operating systems, develop multiplatform systems. He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she can communicate in Hungarian and in English about professional issues, he/she uses the terms of information technology in a creative way. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* - He/she genuinely represents the professional principles of engineering and information technology fields. - He/she is open to acquire new methods, programming languages and develop skills to use them. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* - He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them. - He/she has a security-conscious attitude in posession of his/her professional knowledge, and is aware of potential threats and opportunities for attack, as well as is prepared to prevent them. *e) additional professional competences:*	
Responsible instructor: Dr. Bolla Kálmán Milán	
Instructor(s):	

Course title, code: Software Engineering, GAINBAN-SZOFTTEC-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 5	
Evaluation type: colloquium	
Recommended semester: 5	
Prerequisites: 100 kredit + Programming Paradigms and Techniques	
Subject description: *Course objectives:; Course contents:*	
Required readings:	
Acquired competences: *a) knowledge:* - He/she knows the operations of hardware and software elements, the technology of their implementation, how to solve problems related to their operation and the possibilities of the interconnection of IT and other technical systems. - He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security. - He/she is familiar with the important software development methodologies, and the notation systems for IT designs and documentation. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* - He/she is able to develop applications, program client-server and WEB, mobile operating systems, develop multiplatform systems. He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she is able to fulfill analytical, specification, planning, development and operation tasks, in addition, he/she applies the development methodology, debugging, testing and quality assurance methods in his/her field. - He/she cooperates with other computer science engineers, electrical engineers during team work, and with other experts during the analysis and solution of a problems. - He/she can communicate in Hungarian and in English about professional issues, he/she uses the terms of information technology in a creative way. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* - He/she genuinely represents the professional principles of engineering and information technology fields. - He/she aims to see through the entire engineering system not only his/her own field. - He/she is open to acquire new methods, programming languages and develop skills to use them. - He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* - He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them.	
Responsible instructor: Dr. habil Johanyák Zsolt Csaba	

Course title, code: Web Programming 2, GAINBAN-WEBPROG2-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 5	
Evaluation type: term mark	
Recommended semester: 5	
Prerequisites: 100 kredit + Web Programming 1	
Subject description: *Course objectives:* The aim of the course is the introduction of the standards, methods and tools of the modern web applications development. *Course contents:* Advanced PHP programming, OOP in PHP, Namespaces in PHP. Presentation of PHP class libraries. Implementing the MVC design pattern in PHP. PHP based frameworks, presentation of a selected framework. Web services, SOAP-based and RESTful web services. Advanced JavaScript programming. Server-side programming in JavaScript, Node.js. JavaScript based frameworks, presentation of a selected framework. In course of the lab classes the students will learn how to utilize in practice the knowledge acquired during the lessons.	
Required readings: Educational materials uploaded by the lecturer to the Internet. [1] Antonio López: Learning PHP 7, Packt Publishing, 2016, ISBN 9781785880544. [2] Lorna Jane Mitchell: PHP Web Services, O'Reilly Media, 2013, ISBN 9781449356569. [3] David Flanagan: JavaScript: The Definitive Guide, Sixth Edition, O'Reilly Media, Inc., 2011, ISBN 9780596805524. [4] Learning Laravel, Free unaffiliated eBook created from Stack Overflow contributors, 2019, letölthető: https://www.computer-pdf.com/web-programming/php/915-tutorial-learning-laravel.html [5] Elektronikus források: https://tutorialspoint.com https://w3schools.com https://www.php.net https://developer.mozilla.org/en-US/docs/Web/JavaScript/About_JavaScript https://laravel.com/docs/8.x/ https://vuejs.org/v2/guide/ https://angular.io/docs https://www.tutorialsteacher.com/nodejs	
Acquired competences: *a) knowledge:* - He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security. - He/she is familiar with the important software development methodologies, and the notation systems for IT designs and documentation. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* - He/she is able to develop applications, program client-server and WEB, mobile operating systems, develop multiplatform systems. He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she cooperates with other computer science engineers, electrical engineers during team work, and with other experts during the analysis and solution of a problems. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:*	

- He/she genuinely represents the professional principles of engineering and information technology fields.
- He/she is open to acquire new methods, programming languages and develop skills to use them.
- He/she makes an effort to work efficiently and to high standards.

d) autonomy and responsibilities:

- He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team.
- He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them.
- He/she has a security-conscious attitude in posession of his/her professional knowledge, and is aware of potential threats and opportunities for attack, as well as is prepared to prevent them.

e) additional professional competences:

Responsible instructor:
Dr. Alvarez Gil Rafael Pedro

Instructor(s):

6th SEMESTER

Course title, code: Application Development Using Web Technologies, GAINBAN-ALKFWEBT-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2*, semester* 6	
Evaluation type: signature	
Recommended semester: 6	
Prerequisites: Web Programming 1 +100 cr	
Subject description: *Course objectives:* Students should familiarize themselves with the software development opportunities provided by cloud technologies and services. *Course contents:* Getting to know Microsoft Azure technologies and services. Differences between Azure IaaS, PaaS, SaaS, reason for existence of creating hybrid environments, and their practical implementation. Activation of Azure and Office 365 subscriptions, main types of subscriptions. Publishing individual developments to PaaS and IaaS services. Scaling off-the-shelf applications. Creation and management of resource sets, virtual networks, storage virtual machines. The main services of Office 365, using your own domain, managing users and groups, importing users, synchronizing users with terrestrial Active Directory (AAD Sync), as well as the steps for creating ADFS, creating hybrid systems. Management of Exchange Online mail server, creation and conversion of mailboxes, mailbox authorizations, migration of mailboxes. Description of other services and solutions of Office 365. Use of Microsoft Azure services, implementation of IaaS, PaaS, SaaS. Use of Office 365 services. Publishing to PaaS, IaaS services. Creating virtual machines, creating a network, using Active Directory in Azure.	
Required readings: Microsoft Azure Essentials: Fundamentals of Azure, Second Edition: https://blogs.msdn.microsoft.com/microsoft_press/2016/09/01/free-ebook-microsoft-azure-essentials-fundamentals-of-azure-second-edition/ Visual Studio Dev Essentials: https://visualstudio.microsoft.com/dev-essentials/	
Acquired competences: *a) knowledge:* - His/her English language skills will be sufficient for the level of training, and to understand English-language literature, to process professional texts, to carry out professional tasks, as well as for continuous professional development. - He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security. - He/she is familiar with the important software development methodologies, and the notation systems for IT designs and documentation. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* - He/she is able to develop applications, program client-server and WEB, mobile operating systems, develop multiplatform systems. He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology. - He/she is able to fulfill analytical, specification, planning, development and operation tasks, in addition, he/she applies the development methodology, debugging, testing and quality assurance methods in his/her	

field.
- He/she can communicate in Hungarian and in English about professional issues, he/she uses the terms of information technology in a creative way.

c) attitude:
- He/she genuinely represents the professional principles of engineering and information technology fields.
- He/she is open to acquire new methods, programming languages and develop skills to use them.
- He/she makes an effort to work efficiently and to high standards.

d) autonomy and responsibilities:
- He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team.
- He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them.

e) additional professional competences:

Responsible instructor:
Dr. Subecz Zoltán

Instructor(s):

Course title, code: Basics of Law, GAINBAN-JOGIISME-1	**Credits:** 4
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 1+1+0, *semester* 6	
Evaluation type: colloquium	
Recommended semester: 6	
Prerequisites: -	
Subject description: *Course objectives:* *Course contents:*	
Required readings:	
Acquired competences: *a) knowledge:* *b) skills:* *c) attitude:* - He/she makes decisions with full respect for the law and ethical standards in decision-making situations requiring a complex approach. - He/she understands and embraces the ethical principles and legal implications of his/her profession. *d) autonomy and responsibilities:* *e) additional professional competences:* - Basic knowledge about promoting health and sustainable development which include the basics of environment, work safety and consumer protection	
Responsible instructor: Dr. Molnár István	
Instructor(s):	

Course title, code: Business Economics, GAINBAN-VALLGAZT-1	**Credits:** 4
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 1+1+0, *semester* 6	
Evaluation type: colloquium	
Recommended semester: 6	
Prerequisites: -	
Subject description: *Course objectives:* *Course contents:*	
Required readings:	
Acquired competences: *a) knowledge:* *b) skills:* *c) attitude:* - He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* *e) additional professional competences:*	
Responsible instructor: Dr. Tóth Ákos	
Instructor(s):	

Course title, code: Developing Mobile Applications 2, GAINBAN-FEJLMOE2-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2, *semester* 6	
Evaluation type: signature	
Recommended semester: 6	
Prerequisites: Java Applications +100 cr	

Subject description:

Course objectives:

The aim of the course is to introduce the basics of application development for the Android platform using the Java programming language.

Course contents:

Course content - lectures:

Android Studio and SDK, emulator. Development options, introduction to Android application components (Activity, Service, Content provider, Broadcast receiver). Building an Android project, using IDE. Basic UI controls, layout management elements, user interface creation. Activity lifecycle model, creating and using fragments. Data binding, image management, creating lists. Architecture components. Using web services, connecting to REST API endpoints.

Course content - labs:

Creating user interfaces, UI controls. Activity lifecycle model. Using fragments. Creating a list-detail view. Using Android Architecture Components. Implementing connection to REST API endpoints.

Mid-term study requirements:

Individual or group solution of a project task assigned by the instructor (using git version manager), presentation and defence of the project at the end of the semester.

Required readings:

[1] Google Android Developers: http://developer.android.com

Acquired competences:

a) knowledge:

- He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security.
- He/she is familiar with the important software development methodologies, and the notation systems for IT designs and documentation.
- He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level.

b) skills:

- He/she is able to develop applications, program client-server and WEB, mobile operating systems, develop multiplatform systems.

He/she can apply his/her knowledge acquired during his/her study to acquire deeper knowledge in the field of information engineering and to process special literature and solve problems related to information technology.

- He/she can communicate in Hungarian and in English about professional issues, he/she uses the terms of information technology in a creative way.
- He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession.

c) attitude:

- He/she genuinely represents the professional principles of engineering and information technology fields.
- He/she is open to acquire new methods, programming languages and develop skills to use them.
- He/she makes an effort to work efficiently and to high standards.

d) autonomy and responsibilities: - He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them. - He/she has a security-conscious attitude in posession of his/her professional knowledge, and is aware of potential threats and opportunities for attack, as well as is prepared to prevent them. *e) additional professional competences:*
Responsible instructor: Dr. Bolla Kálmán Milán
Instructor(s): Dr. Bolla Kálmán Milán

Course title, code: Game Development, GAINBAN-JATEFEJL-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 50 (credit %), *Practice:* 50 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 2+0+2, *semester* 6	
Evaluation type: signature	
Recommended semester: 6	
Prerequisites: Introduction to Artificial Intelligence + 100 cr	

Subject description:

Course objectives:

The aim of this course is to introduce the use of the game developing environments through the Unity IDE.

Course contents:

Introduction to game architectures and game-engines. Elements of a Unity project: assets, Scenes, GameObjects and Components. The Sprite Renderer, the Transform and the Script component. The structure of a Unity script. Basic mathematical tools and the transform methods. Basic console and mouse control tools. The 2D physics simulator and the collider components. GameObject hierarchy and its handling in scripts. Destroying and cloning of GameObject instances. 2D animation techniques in Unity. Using the Graphical User Interface and the control's event handler methods. The 3D game engine: similarities and differences compared to the 2D architecture. Importing 3D models and animations. The 3D navigation system in Unity.

Handling the Unity game-engine: the structure of the project and basic editor tools. Writing and running C# scripts in Unity. Writing simple state-machine algorithms. Creating elementary games. Using the Physics Simulator in Unity. Creating animations and animation state-machines. Using the 3D game-engine in Unity.

Required readings:

[1] Will Goldstone: Unity 3.x Game Development Essentials, Packt Publishing 2011, ISBN 978-1-84969-144-4, http://shadowfun.de/unity/tutorials/unity3.x_game_development_essentials.pdf [2] Reid Perkins-Buzo: Unity 2D Tutorial, http://www.lumen-media.org/Sites/game_tutorials/Unity_2D_game_tutorial.pdf [3] Venita Pereira: Learning Unity 2D Game Development by Example, Packt Publishing, 2014, ISBN-13: 978-1783559046

Acquired competences:

a) knowledge:

- He/she knows the main programming paradigms, programming languages, development tools. His/her knowledge covers the modelling of IT systems, creation of database based systems, as well as the structure, operation and implementation of computer networks. His/her knowledge covers the characteristics of intelligent systems, the specificity of mobile application development, the management of state-of-the art general purpose operating systems, as well as the aspects of IT security.
- He/she is familiar with the important software development methodologies, and the notation systems for IT designs and documentation.
- He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level.

b) skills:

- He/she uses the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of information technology in his/her engineering work for the design of information systems.
- He/she can communicate in Hungarian and in English about professional issues, he/she uses the terms of information technology in a creative way.

c) attitude:

- He/she genuinely represents the professional principles of engineering and information technology fields.
- He/she is open to acquire new methods, programming languages and develop skills to use them.
- He/she is open to get to know other fields which employ information technology tools, and open to work out information technology soultions in cooperation with the experts of other areas.

- He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* - He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team. *e) additional professional competences:*
Responsible instructor: Dr. Kovács Tamás
Instructor(s): Dr. Kovács Tamás

Course title, code: IT Project, GAINBAN-INFOPROJ-1	**Credits:** 5
Study mode: full-time	**Curriculum:** 2021
Course category: compulsory	
Degree of theoretical or practical nature of the subject, training character: *Theory:* 0 (credit %), *Practice:* 100 (credits %)	
Type of lessons: *Weekly timetable (lecture + seminar + lab):* 0+0+1, *semester* 6	
Evaluation type: term mark	
Recommended semester: 6	
Prerequisites: 120 cr	
Subject description: *Course objectives:* *Course contents:*	
Required readings:	
Acquired competences: *a) knowledge:* - His/her English language skills will be sufficient for the level of training, and to understand English-language literature, to process professional texts, to carry out professional tasks, as well as for continuous professional development. - He knows the vocabulary and special terms of the engineering profession in the Hungarian and English languages at least on the basic level. *b) skills:* - He/she uses the principles and methods of natural sciences (mathematics, physics, other natural sciences) relevant to the field of information technology in his/her engineering work for the design of information systems. - He/she constantly improves his/her knowledge and keeps up with the development of the computer engineering profession. *c) attitude:* - He/she genuinely represents the professional principles of engineering and information technology fields. - He/she makes an effort to work efficiently and to high standards. *d) autonomy and responsibilities:* - He/she feels responsible for IT systems analysis, development and operation, both individually and as part of a team. - He/she reveals the weaknesses of the technologies applied, risks of processes and initiates measures which reduce them. *e) additional professional competences:*	
Responsible instructor: Dr. Bolla Kálmán Milán	
Instructor(s):	