Subject name: **Architectures and Embedded Systems**	**Neptun code:** Full time: GEVAU218-Ma Part time: **Organizational unit:** Automation and Communication Technology
	Type of subject: SZT4
Responsible Lecturer: Dr József Vásárhelyi, associate professor	
Co-Lecturer(s): Dr Ahmed Bouzid	
Suggested semester: 1F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:
Introduction to embedded systems and architectures, get familiar with embedded system design and system on chip architectures.
Knowledge: Knowledge of widely applicable problem-solving techniques required to develop technical IT systems. An understanding of the principle of the scientific and engineering methods required for the development of IT applications.
Skills: Ability to apply and use the acquired knowledge in practice. Ability to use problem-solving techniques for software and application development. Ability to process new problems and phenomena arising on the boundaries of knowledge of sciences related to information technology.
Attitude: Openness and commitment to self-education, self-development, to deepen and extend their own knowledge and understanding in the field of natural, engineering and information sciences. Initiative to solve problems, ability to make informed decisions, not avoiding personal responsibility.
Autonomy and responsibility: Responsibility for complying with and enforcing deadlines. Ability to work in team, as a specialist in a subfield, and lead a team in a responsible way.

Subject description:
Introduction to Programmable SoCs; The ARM Cortex-M0 Processor Architecture part-1; The ARM Cortex-M0 Processor Architecture part-2; The AMBA3 AHB Lite Bus Architecture; Design and Implementation of an AHB SRAM Memory Controller; Design and Implementation of an AHB UART peripheral; Design and Implementation of an AHB timer, a GPIO peripheral; Design and Implementation of user peripheral; Program SoC using C; ARM CMSIS and Software Drivers; Application Programming Interface (API) and Final Application: Embedded system with Linux; Using Zed Board and Xilinx Vivado Software

Assignment and requirements of signature (full time):
Written examination test + homework during the semester to evaluate the student's understanding of the subject. Evaluation: 0-39%:1; 40-54%: 2; 55-69%: 3; 70-84%: 4; 85-100%: 5.

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):
Small projekt + homework during the semester to evaluate the student's understanding of the subject. Evaluation: 0-39%:1; 40-54%: 2; 55-69%: 3; 70-84%: 4; 85-100%: 5.

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:
1. The lecturer presentation notes, booklet, ppt slides, etc.
2. Crockett L. H., Elliot R. A., Enderwity M. A., Stewart R. W.: The Zynq Book, Embedded processing with ARM Cortex A9 on the Xilinx Zynq-7000 All Programmable SoC. www.zynqbook.com
3. Labrossse J.J et all: Embedded Software know it all, Newnes, ISBN 978-07506-8582-5, 2008, pp.770.
4. Labrosse J.J: MicroC/OS-II The real-time kernel, CMP Books, ISBN 1-57820-103-9, 2002, pp. 606.

5. Sloss A. N., Symes D., Wright C.: ARM System Developer"s Guide Designing and Optimizing System Software, Morgan Kaufmann Publishers, ISBN 1-55860-874-5, 2004, pp. 689

Suggested readings:

1. The lecturer presentation notes, booklet, ppt slides, etc.
2. Crockett L. H., Elliot R. A., Enderwity M. A., Stewart R. W.: The Zynq Book, Embedded processing with ARM Cortex A9 on the Xilinx Zynq-7000 All Programmable SoC. www.zynqbook.com
3. Labrossse J.J et all: Embedded Software know it all, Newnes, ISBN 978-07506-8582-5, 2008, pp.770.
4. Labrosse J.J: MicroC/OS-II The real-time kernel, CMP Books, ISBN 1-57820-103-9, 2002, pp. 606.
5. Sloss A. N., Symes D., Wright C.: ARM System Developer"s Guide Designing and Optimizing System Software, Morgan Kaufmann Publishers, ISBN 1-55860-874-5, 2004, pp. 689

Subject name: **Environmental Management**	**Neptun code:** Full time: GEVGT301-Ma Part time: **Organizational unit:** Energy Engineering and Chemical Machinery
	Type of subject: GH2
Responsible Lecturer: Dr Szamosi Zoltán, associate professor	
Co-Lecturer(s): Dr Szamosi Zoltán	
Suggested semester: 1F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 1 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The aim is to present the energy problem of the Earth, and human being. During the course the students will introduced to renewable energy sources and the fossil fuel dependent society.

Knowledge: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Comprehensive understanding of global social and economic processes. Knowledge and understanding of basic principles, boundaries of the epistemic and functional system of the engineering field and the expected directions of development and innovation.

Skills: Knowledge of general and specific principles, rules, relations and procedures pertaining to mathematics, natural and social sciences necessary to work in the field of engineering. Ability to process, systemise and analyse information gained through the operation of mechanical systems and processes, as well as to draw conclusions. Ability to design and manage the use of technical, economic, environmental and human resources in a complex way.

Attitude: Openness and aptness to know, accept and credibly communicate professional and technological development and innovation in engineering. Commitment to professional and ethical values related to engineering. Striving to organise and perform tasks in accordance with environmentally and health conscious, as well as sustainability expectations. Striving to enforce the requirements of sustainability and energy efficiency.

Autonomy and responsibility: Responsibility for sustainability, health and safety culture at work, as well as environmental consciousness. Making informed decisions individually after consultations with representatives from diverse fields (primarily that of law, economics, energy management, environmental protection), taking responsibility for the decisions. Make decisions based on principles and applicability of environmental protection, quality assurance, consumer protection, product responsibility, equal rights to accessibility, as well as the basic principles of occupational health and safety, technological, economic and legal regulations, moreover basic requirements of engineering ethics.

Subject description:

The structure of the energy consumption, composition, energymix and the related problems. Energy sources and their usage and the distribution all around the globe. Possibilities of electricity production. The resources of energy sources and the possibility of the depletion time and their causes. The CO2 content in the atmosphere and the possible causes, possible ways to decreasing it. The alternatives of the fossil fuels. Nuclear energy. Hydro energy. Pump-storage hydro power plants: as an efficient way of energy storage. Biomass usage. Energy density increment technologies of biomass. Mechanical and thermal process. Possible biomass replacement of crude oil. Biomass as a plastic source.

Assignment and requirements of signature (full time):

The condition for obtaining the practical mark is the average of two written in-house papers written during the semester, min. 50% fulfillment. On a five-point scale: 0-50%: insufficient, 51% -65%: sufficient, 66% - 80%: medium, 81% -92%: good, above 92%: excellent. If the requirements of a particular exam differ from this, this will be indicated on the exam sheet
Assignment and requirements of signature (part time): The condition for obtaining the practical mark is the average of two written in-house papers written during the semester, min. 50% fulfillment
Requirement end evaluation of the practical mark/ exam (full time): The condition for obtaining the practical mark is the average of two written in-house papers written during the semester, min. 50% fulfillment. On a five-point scale: 0-50%: insufficient, 51% -65%: sufficient, 66% - 80%: medium, 81% -92%: good, above 92%: excellent. If the requirements of a particular exam differ from this, this will be indicated on the exam sheet
Requirement end evaluation of the practical mark/ exam (part time): The condition for obtaining the practical mark is the average of two written in-house papers written during the semester, min. 50% fulfillment. On a five-point scale: 0-50%: insufficient, 51% -65%: sufficient, 66% - 80%: medium, 81% -92%: good, above 92%: excellent. If the requirements of a particular exam differ from this, this will be indicated on the exam sheet
Required readings: 1. David J Mackay: Sustainable energy without hot air, Cambridge, 2008 2. John Blewitt: Understanding Sustainable Development, Earthscan, 2008 3. Richard S. Stein, Joseph Power: Energy problem, World Scientific, USA 2011
Suggested readings: 1. Szamosi Zoltán: Mezőgazdasági melléktermékek energiasűrűség-növelésének vizsgálata, Miskolc, 2016 2. P.C.A Bergman: The TOP process, ECN, 2005 3. Ram B. Gupta: Gasoline, diesel and ethanol biofuels from grasses and plants, Cambridge University Press, 2010

Subject name: **Project Management**	**Neptun code:** Full time: GTVSM7003M Part time: **Organizational unit:** Fac. of Economics
	Type of subject: GH1
Responsible Lecturer: Veresné Dr. Somosi Mariann, Egyetemi tanár	
Co-Lecturer(s): Tóthné Kiss Anett, mesteroktató	
Suggested semester: 1F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 1 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

This course aims to provide students with the basic tools and techniques of project management, to demonstrate the importance of project management knowledge for future career decision making, and to reinforce project management skills by means of experiential learning and lecture-based methodologies.

Knowledge: Having an English language proficiency sufficient to complete the programme, review English language literature, to comprehend and process texts of specific vocabulary and to perform professional tasks being qualified for as well as to continue professional self-education.

Skills: Ability to reveal and understand general rules and relationships. Ability to apply and use the acquired knowledge in practice. Expertise, analysis, design and implementation skills of their specialization. Ability to recognise and solve routine problems, as well as to come up with original ideas. Ability to cooperate with the experts in the application environment in a professional way.

Attitude: Ability to perform development tasks at a professionally high level taking quality into consideration, as well as to ascertain the faultlessness of the developed systems. Openness and commitment to self-education, self-development, to deepen and extend their own knowledge and understanding in the field of natural, engineering and information sciences. Initiative to solve problems, ability to make informed decisions, not avoiding personal responsibility. Assessing their subordinates' and their own performance in a realistic and unbiased way. Working in a creative and flexible way, recognising and solving problems based on intuition and methodology.

Autonomy and responsibility: Responsibility for complying with and enforcing deadlines. Ability to work in team, as a specialist in a subfield, and lead a team in a responsible way.

Subject description:

Lectures+ Seminars:

week1. Basic informations about the subject..

week2. Foundation Principles of Project Management. Basic definitions of PM. Type of projects. Project scope management.

week3. Project life cycle. Definig the Project. Project Documents.

week4. Project planing. Resource planning and costing.

week5. Stakeholder analysis. Project risk management. Teamwork during the project.

week6. Work breakdown structure. GANTT diagram.. Fulfilment of resource plan. Milestone events.

week7. Project metrics. Project fulfilment strategy. Feasibility study

week8 Project control. Project organisations. Management of R&D projects

week9.. Project Portfolio Management.

week10. Projekt management competency measurement with online software

week11. Project supporting softwares. (SAP, MS Project)

week12. Teamwork presentation

week13. Colsulation week14. Written-exam
Assignment and requirements of signature (full time): Instructor's signature and evaluation: Mid-semester tasks: case assignment and presentation (30% of term mark), competency test (30% of the term mark) Attendance and participation in lectures and seminars: 10%, Examination: Written examination (30% of term mark)
Assignment and requirements of signature (part time):
Requirement end evaluation of the practical mark/ exam (full time): Instructor's signature and evaluation: Mid-semester tasks: case assignment and presentation (30% of term mark), competency test (30% of the term mark) Attendance and participation in lectures and seminars: 10%, Examination: Written examination (30% of term mark)
Requirement end evaluation of the practical mark/ exam (part time):
Required readings: Essential Reading: 1. Course material (ppt slides; handouts) 2. E. Verzuh: Project Management, 2003. 3. PMI Standards Committee: Project Management Body of Knowledge, 2006.
Suggested readings: Recommended Additional Reading: 1. J. G. Monks: Operations Management, McGraw-Hill, 1982. Chapters 12, 13. 2. https://www.academia.edu/3438417/The_project_managers_leadership_style_as_a_success_factor_on_projects_a_literature_review

Subject name: **Innovation Management for Engineers**	**Neptun code:** Full time: MAKMKT530N Part time: **Organizational unit:** Fac. of Mat. Sci. & Eng.
	Type of subject: GH1
Responsible Lecturer: Dr. Csaba Deák (PhD), professor	
Co-Lecturer(s): Dr. Anett Leskó (PhD)	
Suggested semester: 1F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 1 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:
The aim of the course is to acquire knowledge related to the management and economic contexts of innovation, which are essential for the development, technical-economic foundation and implementation of competitive development strategies and tactics.
Knowledge: Knowledge of widely applicable problem-solving techniques required to develop technical IT systems.
Skills: Ability to apply and use the acquired knowledge in practice. Expertise, analysis, design and implementation skills of their specialization. Ability to process new problems and phenomena arising on the boundaries of knowledge of sciences related to information technology. Ability to recognise and solve routine problems, as well as to come up with original ideas. Ability to view IT management of technical, economic and human resources as a system.
Attitude: Initiative to solve problems, ability to make informed decisions, not avoiding personal responsibility. Examining the opportunities of setting research, development and innovation objectives and striving to achieve them during their work. Working in a creative and flexible way, recognising and solving problems based on intuition and methodology.
Autonomy and responsibility: Ability to work in team, as a specialist in a subfield, and lead a team in a responsible way.

Subject description:
Types of innovation; The process of innovation; Creative techniques; Selection; Product innovation; Design Thinking; Utilization of results; Process innovation; Business model innovation; Startup world; Student presentation

Assignment and requirements of signature (full time):
Team assignments, presentation

Assignment and requirements of signature (part time):
Team assignments, presentation

Requirement end evaluation of the practical mark/ exam (full time):
Based on the tasks completed during the semester (50%), the quality of the presentations (10%), active participation (10%), theoretical preparation (40%), a five-level evaluation is performed in the case of the practical mark. (1: 0-50%,; 2: 51-66%; 3: 67-75%; 4: 76-86%; 5: 87-100%)

Requirement end evaluation of the practical mark/ exam (part time):
Based on the tasks completed during the semester (50%), the quality of the presentations (10%), active participation (10%), theoretical preparation (40%), a five-level evaluation is performed in the case of the practical mark. (1: 0-50%,; 2: 51-66%; 3: 67-75%; 4: 76-86%; 5: 87-100%)

Required readings:

1.Tidd,J- Bessant, J. - Pavitt, K: Managing Innovation: Integrating Technological, Market, and Organizational Change. John Wiley & Sons, 2013 ISBN-10: 111836063
2.Wulfen, G. (2013) The Innovation Expedition: A Visual Toolkit to Start Innovation. Amsterdam: BIS Publishers.
3.Cooper, R.G. (2017) Winning at New Products: Creating Value Through Innovation. 5th edn. New York: Basic Books, Perseus Books Group.

Suggested readings:

1.OECD (2002), Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development [Online]. Available at: https://dx.doi.org/10.1787/9789264199040-en (Accessed: 11 Dec 2002).
2.OECD and EUROSTAT (2019) Oslo Manual: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th edn., The Measurement of Scientific, Technological and Innovation Activities [Online]. Available at: https://doi.org/10.1787/9789264304604-en (Accessed: 22 Oct 2019).
3.Mauborgne, René: Blue Ocean Strategy. Boston, Harvard Business School Press, 2005. ISBN: 1-59139-619-0.

Subject name: **Operation Systems and Networks**	**Neptun code:** Full time: GEIAL501-Ma Part time: **Organizational unit:** Information Science
	Type of subject: SZT5
Responsible Lecturer: Dr. Vincze Dávid, associate professor	
Co-Lecturer(s): Dr. Kovács Szilveszter	
Suggested semester: 1F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The goal of the subject is the introduction of the core operating systems and networks of the information infrastructure. The students became familiar with the main features of the core operating systems and networks and will be able to make decisions in the essential questions related to these areas of projects in informatics.

Knowledge: Having an English language proficiency sufficient to complete the programme, review English language literature, to comprehend and process texts of specific vocabulary and to perform professional tasks being qualified for as well as to continue professional self-education. Knowledge of widely applicable problem-solving techniques required to develop technical IT systems.

Skills: Ability to reveal and understand general rules and relationships. Ability to apply and use the acquired knowledge in practice. Expertise, analysis, design and implementation skills of their specialization. Ability to develop complex IT systems. Ability to use the tools and formal methods of information technology on a skill level. Ability to analyse the performance of IT systems, to use analytical, simulation and measurement methods. Ability to cooperate with the experts in the application environment in a professional way. Understanding of the application requirements. Ability to explain suggestions to the experts in the application environment.

Attitude: Initiative to solve problems, ability to make informed decisions, not avoiding personal responsibility. Examining the opportunities of setting research, development and innovation objectives and striving to achieve them during their work. Working in a creative and flexible way, recognising and solving problems based on intuition and methodology.

Autonomy and responsibility: Responsibility for complying with and enforcing deadlines. Holding an IT position independently, maintaining the whole workflow in a professionally responsible way. Ability to work in team, as a specialist in a subfield, and lead a team in a responsible way. Ability to develop and operate systems containing operational critical and sensitive information based on their professional competencies.

Subject description:

Technologies of mainframe computing (MPP, HW redundancy, RAID, Clustering, Storage Networks), Super computers, Embedded operating systems, Real-time operating systems, Basic concepts and types of operating system virtualization, Structures of modern file systems, Security and protection mechanisms. Virtualization technologies, the basics of Cloud technologies. Concepts and structures of computer networks, Medias and devices. Internetworking. Ethernet, IPv4, IPv6, TCP/IP, the structure of the Internet, nodes (internet exchange, peering), High speed networks (Infiniband, Omnipath).

Assignment and requirements of signature (full time):

Successfull written examination during the semester with at least 50% grade.

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time): Written and oral exam. The minimal requirement is the 50% grade of the written examination. 0%-50% : fail, 51%-62% : pass, 63%-75% : satisfactory, 76%-88% : good, 89%-100% : excellent
Requirement end evaluation of the practical mark/ exam (part time):
Required readings: 1. Hubbert Smith: Data Center Storage: Cost-Effective Strategies, Implementation, and Management, 2011, 978-1439834879. 2. Chris Takemura and Luke S. Crawford: Book of Xen, 2009, 978-1-59327-186-2 3. Tanenbaum, A.S.: Számítógép-hálózatok, Panem, 2003, 963 545 384 1
Suggested readings: 1. Stephen A. Thomas: IP kapcsolás és útválasztás, 2002, 9789639301412 2. Mellanox White Paper: Introduction to Infiniband (http://www.mellanox.com/pdf/whitepapers/IB_Intro_WP_190.pdf)

Subject name: **Discrete Mathematics and Applications**	**Neptun code:** Full time: GEMAN383-Ma Part time: **Organizational unit:** Mathematics
	Type of subject: TT1
Responsible Lecturer: Dr. Szigeti Jenő, Professor	
Co-Lecturer(s): Dr. Dávid Csaba Kertész, assistant professor	
Suggested semester: 1F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The aim of the course is to familiarize students with basic matematical concepts and results that are useful in computer science. The course covers some group, ring and field theory, graph theory and lattice theory.

Knowledge: Having an English language proficiency sufficient to complete the programme, review English language literature, to comprehend and process texts of specific vocabulary and to perform professional tasks being qualified for as well as to continue professional self-education.

Skills: Ability to reveal and understand general rules and relationships. Ability to apply and use the acquired knowledge in practice. Ability to recognise and solve routine problems, as well as to come up with original ideas.

Attitude: Openness and commitment to self-education, self-development, to deepen and extend their own knowledge and understanding in the field of natural, engineering and information sciences. Initiative to solve problems, ability to make informed decisions, not avoiding personal responsibility. Working in a creative and flexible way, recognising and solving problems based on intuition and methodology.

Autonomy and responsibility: Responsibility for complying with and enforcing deadlines.

Subject description:

Pascal's triangle, Fibonacci numbers, semigroups and groups, Lagrange and Cauchy theorems for finite groups, rings and fields, number fields, the algebra of polynomials, Euclidean algorithm, irreducible factorizations of polynomials, introduction to graph-theory, trees, the greedy algorithm, planar graphs, the chromatic number, bipartite graphs, matchings, graphs and matrices, partial and linear orders, the order dimension of a poset, lattices and complete lattices, distributive and Boolean lattices, Boolean functions, polynomial form, disjunctive and conjunctive normal forms, clones of Boolean functions, maximal clones, completeness, Post lattice, De Morgan and Heyting algebras.

Assignment and requirements of signature (full time):

One test at the end of the semester consisting of practical exercises. The minimum requirement for the signature is 50%.

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):

Written exam about the theoretical matherial in the exam period.

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:

1. L. Lovász, J. Pelikán, K. Vesztergombi: Discrete Mathematics: Elementary and Beyond, Springer, 2003
2. S. N. Burris: Logic for mathematics and Computer Science, Prentice Hall, 1998
3. Stephan Foldes: Fundamental Structures of Algebra and Discrete Mathematics, Wiley, 1994
4. Wallis, W.D: A Beginner's Guide to Discrete Mathematics, Birkhauser, 2002

Suggested readings:

1. Rosen, Kennth H. : Discrete Mathematics and its Applications, McGraw-Hill, 5th edition, 2003
2. Goodaire, E. and Parmenter, M : Discrete Mathematics with Graph Theory, 2nd Edition; Prentice Hall, 2002

Subject name: **Numerical Methods and Optimization**	**Neptun code:** Full time: GEMAK116-Ma Part time: **Organizational unit:** Mathematics
	Type of subject: TT4
Responsible Lecturer: Dr. Körei Attila, associate professor	
Co-Lecturer(s):	
Suggested semester: 1F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

To provide suitable and effective methods for obtaining approximate representative numerical results of the problems. To solve complex mathematical problems using only simple arithmetic operations.

To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems. To improve the student's skills in numerical methods and optimization by using computer facilities.

Knowledge: Having an English language proficiency sufficient to complete the programme, review English language literature, to comprehend and process texts of specific vocabulary and to perform professional tasks being qualified for as well as to continue professional self-education. Knowledge of widely applicable problem-solving techniques required to develop technical IT systems.

Skills: Ability to reveal and understand general rules and relationships. Ability to apply and use the acquired knowledge in practice. Ability to use problem-solving techniques for software and application development.

Attitude: Initiative to solve problems, ability to make informed decisions, not avoiding personal responsibility.

Autonomy and responsibility: Ability to work in team, as a specialist in a subfield, and lead a team in a responsible way.

Subject description:

1. Preliminaries: basic concepts of linear algebra and analysis
2. Representation of numbers, number systems, different types of errors
3. Direct and iterative methods for solving systems of linear equations
4. Computing eigenvalues and eigenvectors.
5. Solving nonlinear equations and nonlinear systems: fixed point method, Newton method
6. Interpolation and the least square method
7. Numerical solution of differential equations. Writing a test of numerical methods.
8. Basic concepts of optimization, classification of optimization problems
9. Linear programming problems. The simplex method.
10. Duality and sensitivity analysis
11. Special LP problems
12. Some methods of unconstrained optimization
13. Constrained optimization: Karush-Kahn-Tucker conditions
14. Writing a test of optimization.

Assignment and requirements of signature (full time):

Two midsemester tests. Over 50% is required for successfull completion.
Assignment and requirements of signature (part time):
Requirement end evaluation of the practical mark/ exam (full time): Written exam. Evaluation: 0-49%: 1, 50-65%: 2, 66-79%: 3; 80-89%: 4, 90-100%: 5.
Requirement end evaluation of the practical mark/ exam (part time):
Required readings: 1. Pardalos, P. M. and Butenko, S.: Numerical Methods and Optimization: An Introduction, CRC Press, Taylor & Francis Group, 2014 2. Cheney, W., Kincaid, D: Numerical Mathematics and Computing, Brooks Cole, 2012. 3. Foulds, L.R.: Optimization Techniques, Springer Verlag, 1981.
Suggested readings: 1. H. Moore: MATLAB for Engineers, Prentice Hall, 2011. 2. Winston, : Operations Research, Brooks/Cole, 1990

Subject name: **Enterprise Application Integration**	**Neptun code:** Full time: GEIAK682-Ma Part time: **Organizational unit:** Information Science
	Type of subject: TT3
Responsible Lecturer: Dr. Nehéz Károly, associate professor	
Co-Lecturer(s):	
Suggested semester: 2S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

Different level of software integration: data level integration, application interface level integration, method call and GUI level integration. Examining middleware's and EAI technology. Inspecting EAI design patterns: message delivery, transformation, creation, message queues, endpoints, system management patterns. Service Oriented Architecture (SOA) design and Enterprise Service Bus. Context of practical classes is to use an opens source ESB systems in practice e.g. JBoss ESB.

Knowledge: Knowledge of widely applicable problem-solving techniques required to develop technical IT systems.

Skills: Ability to use the tools and formal methods of information technology on a skill level.

Attitude: Ability to perform development tasks at a professionally high level taking quality into consideration, as well as to ascertain the faultlessness of the developed systems.

Autonomy and responsibility: Responsibility for complying with and enforcing deadlines.

Subject description:

Basic concepts: Data and information, Acquisition process
Data protection and data security, Threats: Viruses, human factor
Data loss and corruption
User authentication methods, Passwords, encryption.
Protection of privacy, destruction of data
Network security knowledge: protocols, devices, network attacks
Virtual private networks
Ethical hacking
Design and implement secure applications

Assignment and requirements of signature (full time):

1 test to be passed at least 40%
1 essay + programming assignents

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):

The exam consists of written and oral parts. Both parts must be passed, minimum level: 50%.
Marks: 0 %- 50% unsatisfactory(1) ; 51% - 63% satisfactory(2) ; 64% - 76% averages(3) 77% - 89% good(4) ; 90% - 100% excellent(5) """

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:

1. Alan G. Konheim: Computer Security and Cryptography (Wiley, 2007, ISBN: 978-0-471-94783-7)
2. John R. Vacca: Computer and Information Security handbook (Morgan Kaufmann, 2009, 844 pages, ISBN 978-0-12-374354-1)

3. Simon Singh: The code book ISBN 0385495323
4. James M. Stewart, Mike Chapple, Darril Gibson - CISSP (ISC)2 Certified Information Systems Security Professional Official Study Guide, 2015, ISBN 1119042712
5. Tony Hsiang-Chih Hsu - Practical Security Automation and Testing: Tools and techniques for automated security scanning and testing in DevSecOps, 2019, ISBN 1789802024

Suggested readings:

1.Vijay Kumar Velu,Robert Beggs : Mastering Kali Linux for Advanced Penetration Testing: Secure your network with Kali Linux 2019.1 – the ultimate white hat hackers' toolkit, Packt Publishing Ltd, 2019. jan. 30
2.Daniel Regalado, Shon Harris, Allen Harper, Chris Eagle, Jonathan Ness, Branko Spasojevic, Ryan Limm, and Stephen Sims: Gray Hat Hacking: The Ethical Hacker's Handbook
3.Andrew S. Tanenbaum - David J. Wetherall: Számítógép-hálózatok, ISBN:9789635455294
4.Kevin Mitnick: The Art of Invisibility
5. Chris Wysopal: Art of Software Security Testing, The Identifying Software Security Flaws, ISBN 0321304861

Subject name: **Modern Database Systems**	**Neptun code:** Full time: GEIAL521-Ma Part time: **Organizational unit:** Information Science
	Type of subject: SZT1
Responsible Lecturer: Dr. Kovács László, Professor	
Co-Lecturer(s):	
Suggested semester: 2S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The main goal of the course
is to show the main different data modelling techniques. Overview of advanced database models as hierarchical models (XML, JSon) ; ORDBMS models , NoSQL models, dokument-based models (MongoDB), gráf adatmodell (Neo4J). Hadoop rendszerek alapjai.

Knowledge: A deeper theoretical and practical knowledge in one or more of the following fields within information technology, depending on their specialization: software design, system simulation and modelling, communication networks, mobile and resource constrained applications, computer graphics and image processing, critical and embedded systems, media information technology, IT security, parallel systems, intelligent systems, computational theory, databases. Knowledge of widely applicable problem-solving techniques required to develop technical IT systems.

Skills: Ability to develop complex IT systems. Ability to analyse the performance of IT systems, to use analytical, simulation and measurement methods.

Attitude: Ability to perform development tasks at a professionally high level taking quality into consideration, as well as to ascertain the faultlessness of the developed systems. Examining the opportunities of setting research, development and innovation objectives and striving to achieve them during their work.

Autonomy and responsibility: Holding an IT position independently, maintaining the whole workflow in a professionally responsible way.

Subject description:

Overview of DB datamodels;
Relational databases; PL/SQL; Hierarchical models: XML database, LDAP database and Java API; LINQ interface, Lambda calculus; ORM systems, Hypenate and myBatis; ORDBMS model and SQL commands; MongoDB datamodel, CRUD commands, database API in Java, Neo4J datamodel, CRUD commands, database API in Java, Cloud databases; overview of Hadoop , HDFS and mapReduce.

Assignment and requirements of signature (full time):

Condition of the signature: Two large
project tasks should be solved during the semester. Topics: RDBMS/ORDBMS and noSQL.

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):

The exam consists of written and oral parts. Both parts must be passed, minimum level: 50%.
Marks: 0 %- 50% unsatisfactory(1) ; 51% - 63% satisfactory(2) ; 64% - 76% averages(3) 77% - 89% good(4) ; 90% - 100% excellent(5) """

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:

1. Kovács László : Adatbázis rendszerek, elektronikus előadásanyag (moodle.iit.uni-miskolc.hu)

2. C. Curcher. Beginning Database Design: From Novice to Professional, Apress Publisher, 2007
3. Professional NoSQL. Edited by Shashank Tiwari. Indianapolis, Ind.: John Wiley & Sons, Inc., 2011

Suggested readings:

1. Eric Redmond - Jim R. Wilson: Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement
2. Hadoop: The Definitive Guide, by Tom White, 2nd edition, Oreilly?s, 2010
3. Sherif Sakr - Eric Pardede: Graph Data Management: Techniques and Applications

Subject name: **Software Engineering**	**Neptun code:** Full time: GEIAL511-Ma Part time: **Organizational unit:** Information Science
	Type of subject: SZT3
Responsible Lecturer: Dr. Mileff Péter, associate professor	
Co-Lecturer(s):	
Suggested semester: 2S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The goal of the course is to present the whole process of modern software engineering including all important compoennts. The students will learn the key technologies required in software industry focusing on agile software development.

Knowledge: An understanding of the principle of the scientific and engineering methods required for the development of IT applications.

Skills: Ability to apply and use the acquired knowledge in practice. Ability to use problem-solving techniques for software and application development.

Attitude: Ability to perform development tasks at a professionally high level taking quality into consideration, as well as to ascertain the faultlessness of the developed systems. Initiative to solve problems, ability to make informed decisions, not avoiding personal responsibility.

Autonomy and responsibility: Holding an IT position independently, maintaining the whole workflow in a professionally responsible way. Ability to work in team, as a specialist in a subfield, and lead a team in a responsible way.

Subject description:

Key concepts in foundation of SE. The software as industry product. Definition of the software product. Key phases of software development. Lifecycle model of the software development. Waterfall model. Evolutionary model of software development. . Component-based SE. Incremental SE. Spiral model. Process model. The main phases in sofware development. Requirement analysis. Functional and non-functional requirements. User-level requirements. Process of requirement analsis. Required documenations in SE. Use.cases
, etnográfia. Validation o fth erequirements. Software planning, Architectural planning. .System architectures. Modularization. Functional pipelines. Control models. Obbject-oriented planning. rapid software development. Agile software development. , extreme programming;verification and validation. Static and dynamic SE techniques. Software quality measures, Product and SE process quality.

Assignment and requirements of signature (full time):

The students solve a group-level development task and every student must cerate and present a report on the performed tasks.

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):

The main requirement to get the signature: active and succesful participation in in large project work and to present the report.

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:

1. Dr. Mileff Péter online segédlete: www.iit.uni-miskolc.hu/~mileff

2. Robert C.: Clean Architecture: A Craftsman's Guide to Software Structure and Design (amazon)
3. Robert C.: The Clean Coder: A Code of Conduct for Professional Programmers

Suggested readings:

1.Ion Sommerville: Szoftverrendszerek fejlesztése, 2007 bővített, második kiadás. Panem Könyvkiadó, Budapest, 2007
2.John Sonmez: Soft Skills: The Software Developer's Life Manual
3. Jon Bentley: Programming Pearls

Subject name: **Information Theory and Cryptography**	**Neptun code:** Full time: GEMAK126-Ma Part time: **Organizational unit:** Mathematics
	Type of subject: TT2
Responsible Lecturer: Dr. Fegyverneki Sándor, associate professor	
Co-Lecturer(s):	
Suggested semester: 2S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

To master basic concepts in information theory, including source coding, and algorithms of channel capacity. To investigate important specific codes and channels. To continue to develop problem-solving skills and to apply these skills to the solving of application problems in communication theory. Be able to apply the gained knowledge to the solution of practical problems in engineering areas through evaluation and selection of appropriate statistical techniques.

Knowledge: Having an English language proficiency sufficient to complete the programme, review English language literature, to comprehend and process texts of specific vocabulary and to perform professional tasks being qualified for as well as to continue professional self-education. An understanding of the principle of the scientific and engineering methods required for the development of IT applications.

Skills: Ability to reveal and understand general rules and relationships. Ability to apply and use the acquired knowledge in practice. Ability to use problem-solving techniques for software and application development.

Attitude: Openness and commitment to self-education, self-development, to deepen and extend their own knowledge and understanding in the field of natural, engineering and information sciences. Initiative to solve problems, ability to make informed decisions, not avoiding personal responsibility.

Autonomy and responsibility: Ability to work in team, as a specialist in a subfield, and lead a team in a responsible way.

Subject description:

1. Repeating of basic concepts of probability theory.
2. Real convex functions. Some inequalities.
3. Measuring of quantity of information. Entropy and its properties.
4. I-divergence and its properties. Classification of sources and codes.
5. Kraft-McMillan inequality, source coding theorem, Shannon-Fano coding, Gilbert-Moore coding, Huffman coding, extended Huffman coding.
6. Block coding. Theorem of general source coding theorem. 1st test.
7. Joint and conditional entropies, mutual information.
8. Types of discrete memoryless channels, BSC, BEC, channel capacity. Arimoto-Blahut algorithms.
9. Channel coding: Hamming weight, Hamming distance, minimum distance decoding, single parity codes.
10. Hamming codes, repetition codes, linear block codes, cyclic codes, syndrome calculation, encoder and decoder;
11. Continuous source, entropy. 2nd test. Continuous channels, minimum entropy method. 12. History and basic cryptographic concepts, protocols, discrete log, and Diffie-Hellman. 13. Public-key cryptosystems and RSA. 14.Security of RSA, authentication,key management . Applications and the future .

Assignment and requirements of signature (full time): Two midsemester tests. Over 50% is required for successfull completion. Evaluation: 0-49%: 1, 50-65%: 2, 66-79%: 3; 80-89%: 4, 90-100%: 5.
Assignment and requirements of signature (part time):
Requirement end evaluation of the practical mark/ exam (full time):
Requirement end evaluation of the practical mark/ exam (part time):
Required readings: 1. R. B. Ash. Information Theory. Interscience, New York. 2000. 2. T. M. Cover, J.A. Thomas. Elements of information theory. Wiley, New York. 1991. 3. D. Salomon. Data Compression, Springer, 2004 4. Norman L. Biggs: Codes: An Introduction to Information Communication and Cryptography, Springer-Verlag London Limited, 2008.
Suggested readings: 1. S. Guiasu. Information theory with applications. McGRAW-HILL, New York. 1977. 2. Xue-Bin Liang. An Algebraic, Analytic and Algorithmic Investigation on the Capacity and Capacity-Achieving Input Probability Distributions of Finite-Input Finite-Output Discrete Memoryless Channels. Department of Electrical and Computer Engineering Louisiana State University, Baton Rouge, LA 70803. 2004. 3. Claude E. Shannon, Warren Weaver: The Mathematical Theory of Communication, Bell System Technical Journal, 1947. 4. . Richard A. Mollin: RSA and PUBLIC-KEY CRYPTOGRAPHY, Chapman and Hall,CRC Press LLC, 2003.

Subject name: **Theory of Error-Correcting Codes**	**Neptun code:** Full time: GEMAN533-Ma Part time: **Organizational unit:** Mathematics
	Type of subject: TT5
Responsible Lecturer: Dr. Rakaczki Csaba, associate professor	
Co-Lecturer(s):	
Suggested semester: 2S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

Coding theory is concerned with successfully transmitting data through a noisy channel and correcting errors in corrupted messages. The aim of the course is to familiarize students with the theory of error-correcting codes. The course covers the simpler families of codes such as linear, Hamming, Reed-Solomon, cyclic, BCH codes with encoding and decoding methods.

Knowledge: Having an English language proficiency sufficient to complete the programme, review English language literature, to comprehend and process texts of specific vocabulary and to perform professional tasks being qualified for as well as to continue professional self-education. An understanding of the principle of the scientific and engineering methods required for the development of IT applications.

Skills: Ability to reveal and understand general rules and relationships. Ability to apply and use the acquired knowledge in practice. Ability to use problem-solving techniques for software and application development.

Attitude: Ability to perform development tasks at a professionally high level taking quality into consideration, as well as to ascertain the faultlessness of the developed systems. Openness and commitment to self-education, self-development, to deepen and extend their own knowledge and understanding in the field of natural, engineering and information sciences. Initiative to solve problems, ability to make informed decisions, not avoiding personal responsibility.

Autonomy and responsibility: Ability to work in team, as a specialist in a subfield, and lead a team in a responsible way. Ability to develop and operate systems containing operational critical and sensitive information based on their professional competencies.

Subject description:

Mathematical background: groups, rings, ideals, factor rings fields, finite fields, constructions, computing in a finite field, multiplicative group of a finite field, vestor spaces, polynomials. Basic notions: Noisy channels, binary symmetric channel, error detection and error correction. Block codes. Hamming distance, minimal distance. Maximal distance codes, perfect codes. Bounds on codes: Singleton, Hamming bounds. Linear codes over finite fields: generator and parity check matrices, dual codes, Hamming codes. Codes and polynomials: Reed-Solomon codes, cyclic codes, generator and check polynomial, cyclic Reed-Solomon codes, encoding, decoding. Error correction in digital media processing (compact disc), BCH codes.

Assignment and requirements of signature (full time):

One midsemester test. Over 50% is required for successfull completion.

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):

Written exam. Evaluation: 0-49%: 1, 50-65%: 2, 66-79%: 3; 80-89%: 4, 90-100%: 5.

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:

1. F.J. MacWilliams and N.J.A. Sloane. The Theory of Error-Correcting Codes. Elsevier

Science Publishers B.V., 1988.
2. San Ling and Chaoping Xing. Coding Theory A First Course, Cambridge University Press, Cambridge, 2004
3. E. R. Berlekamp: Algebraic Coding Theory. Aegean Park Pr; 1984

Suggested readings:

1.Henk C.A. van Tilborg, CODING THEORY a first course, https://www.win.tue.nl/~henkvt/images/CODING.pdf
2.VERA PLESS, Introduction to the Theory of Error-Correcting Codes, Copyright © 1998 John Wiley & Sons, Inc
3.J. H. van Lindt: Introduction to Coding Theory, Springer, GTM, 1982

Subject name: **Geometric Modelling and its applications**	**Neptun code:** Full time: GEAGT232-Ma Part time: **Organizational unit:** Mathematics
	Type of subject: SZT2
Responsible Lecturer: Dr. Imre Juhász, professor	
Co-Lecturer(s): Sándor Lajos Imre Piller	
Suggested semester: 2S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:
To get familiar with the basics of curve and surface description methods used in computer aided geometric design. Their application is also an objective of the course.
Knowledge: A deeper theoretical and practical knowledge in one or more of the following fields within information technology, depending on their specialization: software design, system simulation and modelling, communication networks, mobile and resource constrained applications, computer graphics and image processing, critical and embedded systems, media information technology, IT security, parallel systems, intelligent systems, computational theory, databases.
Skills: Ability to process new problems and phenomena arising on the boundaries of knowledge of sciences related to information technology.
Attitude: Openness and commitment to self-education, self-development, to deepen and extend their own knowledge and understanding in the field of natural, engineering and information sciences.
Autonomy and responsibility: Responsibility for complying with and enforcing deadlines.

Subject description:
Coordinate systems, homogeneous coordinates, the matrix representation of coordinate and point transformations. Description of curves, interpolating and approximating curves, spline curves. Osculating plane, arc length, curvature, torsion, Frenet frame. The definition and properties of Hermite arcs, Ferguson and Overhauser spline curves. The de Casteljau algorithm, the parametric description and properties of the Bézier curves. The parametric representation and properties of B-spline curves. Mathematical representation of surfaces, tangent plane, normal vector, swept surfaces, interpolating and approximating surfaces, specifically Coons patches, Bézier surfaces and B-spline surfaces. The generation and properties of rational Bézier and B-spline surfaces. Surface and solid modelling in CAD systems. The basics of image processing.

Assignment and requirements of signature (full time):
A programming or design project.
The condition of signature is a programme capable of functioning or a 3D CAD modell, which works out the objective and the student can explain her/his solution.

Assignment and requirements of signature (part time):
A programming or design project.
The condition of signature is a programme capable of functioning or a 3D CAD modell, which works out the objective and the student can explain her/his solution.

Requirement end evaluation of the practical mark/ exam (full time):

The student's project is marked and this mark is taken into account in the final mark of the exam with the weight 1/3. The evaluation of the exam is based on the performance in the following way:
0 - 49% : 1
50 - 64% : 2
65 - 79% : 3
80 - 89% : 4
90 - 100% : 5

Requirement end evaluation of the practical mark/ exam (part time):
The student's project is marked and this mark is taken into account in the final mark of the exam with the weight 1/3. The evaluation of the exam is based on the performance in the following way:
0 - 49% : 1
50 - 64% : 2
65 - 79% : 3
80 - 89% : 4
90 - 100% : 5

Required readings:
1. Juhász, I.: Curve and surface modelling, e-lecture notes, 2020. 141 p.
2. Farin, G.:Curves and Surface for Computer-Aided Geometric Design, 5th edition Morgan-Kaufmann, 2002

Suggested readings:
1. Hoschek, J., Lasser, D.: Fundamentals of Computer Aided Geometric Design, AK Peters, Wellesley, 1993.
2. Gallier, J.: Curves and Surfaces in Geometric Modeling, Morgan Kaufmann Publisher, San Francisco, 2000.
3. Farin, G., Hoschek, J., Kim, M.S.: Handbook of Computer Aided Geometric Design, North-Holland, 2002.

Subject name: **Development of Distributed Systems**	**Neptun code:** Full time: GEIAL519-Ma Part time: **Organizational unit:** Information Science
	Type of subject: DSZ1
Responsible Lecturer: Dr. Krizsán Zoltán, associate professor	
Co-Lecturer(s):	
Suggested semester: 3F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:
The students will learn the concepts and technologies of web-service oriented software development. Presentation of the platforrm and implementation independent component integration.
Knowledge: An understanding of the principle of the scientific and engineering methods required for the development of IT applications.
Skills: Ability to apply and use the acquired knowledge in practice. Ability to use problem-solving techniques for software and application development.
Attitude: Ability to perform development tasks at a professionally high level taking quality into consideration, as well as to ascertain the faultlessness of the developed systems. Initiative to solve problems, ability to make informed decisions, not avoiding personal responsibility.
Autonomy and responsibility: Holding an IT position independently, maintaining the whole workflow in a professionally responsible way. Ability to work in team, as a specialist in a subfield, and lead a team in a responsible way.

Subject description:
Scrum, Jenkins, Jira, JUnit, Maven, MVC pattern, Spring Framework, EasyMock, LiquiBase, Scrum, grooming, Spring MVC, Spring security, JSON,

Assignment and requirements of signature (full time):
Students solve a complex home work SE project covering both design and implementation and using own sotware repository
One classroom test,i min 40%
One home proejct work,
Presentation of the proejct report

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):
written exam:
minimum level: 40%.
Marks: 0 %- 40% unsatisfactory(1) ; 41% - 54% satisfactory(2) ; 55% - 69% averages(3) 70% - 84% good(4) ; 85% - 100% excellent(5) """

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:
1. http://spring.io
2. https://maven.apache.org/
3. https://junit.org/junit5/
4. https://www.atlassian.com/software/jira

Suggested readings:

1. https://www.tutorialspoint.com/spring_boot
2. https://www.baeldung.com/spring-boot
3. https://www.tutorialspoint.com/maven/index.htm

Subject name: **Data Analysis and Data Mining**	**Neptun code:** Full time: GEIAL526-Ma Part time: **Organizational unit:** Information Science
	Type of subject: DSZ3
Responsible Lecturer: Dr. Kovács László, professor	
Co-Lecturer(s):	
Suggested semester: 3F	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The goal of the course is to
show the different analysis techniques used in decision support. It inludes the foundadtion of statistical tests, the OLAP and data cube, data warehouse techniologies and the basic data mining methods.

Knowledge: A deeper theoretical and practical knowledge in one or more of the following fields within information technology, depending on their specialization: software design, system simulation and modelling, communication networks, mobile and resource constrained applications, computer graphics and image processing, critical and embedded systems, media information technology, IT security, parallel systems, intelligent systems, computational theory, databases. Knowledge of widely applicable problem-solving techniques required to develop technical IT systems.

Skills: Ability to develop complex IT systems. Ability to analyse the performance of IT systems, to use analytical, simulation and measurement methods.

Attitude: Ability to perform development tasks at a professionally high level taking quality into consideration, as well as to ascertain the faultlessness of the developed systems. Examining the opportunities of setting research, development and innovation objectives and striving to achieve them during their work.

Autonomy and responsibility: Holding an IT position independently, maintaining the whole workflow in a professionally responsible way.

Subject description:

Elements, categories of decision
support systems. Foundation of statistical calculations, normal distribution, t-test and F-test. regression. Concepts of OLTP and OLAP systems Overview and architecture of Data Warehouse. ETL processes, data cleansing, MD model structural and operational parts, MD algebra, MDX comand language ; MD operations in Saiku and Mondrian. Overview of data mining tecnniques, application areas. Main methods in DM. discovery of association rules. apriori-algorithm.Overview of clustering, k.means and HAC methods. Overview of classification, Bayes classifier, decision tree, SVM method. Using neural networks in classsification, Back-propagation NN. DM programming in Python.

Assignment and requirements of signature (full time):

Condition of the signature: Two large
project tasks should be solved during the semester. Topics: MD/MDX query and data mining

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):

The lab mark is based on the results of the home projexcts and of a theoretical classroom test . Both parts must be passed, minimum level: 50%.

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:

1. J. Han – M. Kamber: Adatbányászat, Koncepciók és technikák, Panem kiad;
2. Kovács László: Adatelemzési és adatbányászati technikák és eszközök;
3. Berson, Smith: Data Warehousing, Data Mining and OLAP. McGraw Hill, 1997

Suggested readings:

1. Fajszi-Cser: Üzleti tudás az adatok mélyén. BME, 2004
2. Berson, Smith: Data Warehousing, Data Mining and OLAP. McGraw Hill, 1997
3. Data mining concepts and techniques (J. Han, M. Kamber, J. Pei)

Subject name: **Integrated Software Systems and Testing**	**Neptun code:** Full time: GEIAL51C-Ma Part time: **Organizational unit:** Information Science
	Type of subject: DSZ2
Responsible Lecturer: Dr. Mileff Péter, associate professor	
Co-Lecturer(s):	
Suggested semester: 4S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The course provides the theory and practice on the development of complex software systems, including sofware integration, software quality metrics and testing.

Knowledge: An understanding of the principle of the scientific and engineering methods required for the development of IT applications.

Skills: Ability to apply and use the acquired knowledge in practice. Ability to use problem-solving techniques for software and application development.

Attitude: Ability to perform development tasks at a professionally high level taking quality into consideration, as well as to ascertain the faultlessness of the developed systems. Initiative to solve problems, ability to make informed decisions, not avoiding personal responsibility.

Autonomy and responsibility: Holding an IT position independently, maintaining the whole workflow in a professionally responsible way. Ability to work in team, as a specialist in a subfield, and lead a team in a responsible way.

Subject description:

Software as a compelx system, socio-technical systems, basic system properties,
System integration, architecture of complex systems, service -oriented architectiure, Desing process of service architecture. .
Foundadtion of software quality; Quality control process, Standards in SW quality control, ;ISO 9000 standards, Quality control handbook; Design of quality control, process of quality control, Quality metrics amd measuing in SW development,
Basic concepts, predictor and control metrics, External and internal metrics, dependencies, Measurement techniques,
static and dynamic metrics, quality models and methods: . Boehm, McCall model;
Extended mdoels:CMMI framework, staged and continoues CMMI. Foundadtion of project manageemnt. General overview. Project planning. Milestones and project phases, results. Crutial factors, bar diagrams and activity graph, Risk analysis, rist identifiaction, risk management, Configuration management,
.

Assignment and requirements of signature (full time):

The condition to get signature: prepare and present a presentation about a sub-topic of the course. Passing all classroom tests.

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):

written exam:
minimum level: 40%.
Marks: 0 %- 40% unsatisfactory(1) ; 41% - 54% satisfactory(2) ; 55% - 69% averages(3) 70% - 84% good(4) ; 85% - 100% excellent(5) """

Requirement end evaluation of the practical mark/ exam (part time):
Required readings: 1. Dr. Mileff Péter online segédlete: www.iit.uni-miskolc.hu/~mileff 2. Robert C.: Clean Architecture: A Craftsman's Guide to Software Structure and Design (amazon) 3. Robert C.: The Clean Coder: A Code of Conduct for Professional Programmers
Suggested readings: 1.Ion Sommerville: Szoftverrendszerek fejlesztése, 2007 bővített, második kiadás. Panem Könyvkiadó, Budapest, 2007 2.John Sonmez: Soft Skills: The Software Developer's Life Manual 3. Jon Bentley: Programming Pearls

Subject name: **Software System Security**	**Neptun code:** Full time: GEIAK647-Ma Part time: **Organizational unit:** Information Science
	Type of subject: DSZ4
Responsible Lecturer: Dr. Hornyák Olivér, associate professor	
Co-Lecturer(s):	
Suggested semester: 4S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** term mark
Credits: 4	**Program:** Full time

Objective and purpose of the subject:
The aim of the course is to
acquaint the student with the basic concepts of computer security, relevant standards, recommendations and good practices. In practical classes the goal is to help learners develop the habit of properly assessing and improving cyber risk posture in real computing, networking, and software systems.
Knowledge: Knowledge of widely applicable problem-solving techniques required to develop technical IT systems.
Skills: Ability to use the tools and formal methods of information technology on a skill level.
Attitude: Ability to perform development tasks at a professionally high level taking quality into consideration, as well as to ascertain the faultlessness of the developed systems.
Autonomy and responsibility: Responsibility for complying with and enforcing deadlines.

Subject description:
Basic concepts: Data and information, Acquisition process
Data protection and data security, Threats: Viruses, human factor
Data loss and corruption
User authentication methods, Passwords, encryption.
Protection of privacy, destruction of data
Network security knowledge: protocols, devices, network attacks
Virtual private networks
Ethical hacking
Design and implement secure applications

Assignment and requirements of signature (full time):
1 test to be passed at least 40%
1 essay + programming assignents

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):
The lab mark is based on the results of the home projexcts and of a theoretical classroom test . Both parts must be passed, minimum level: 40%.

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:
1. Alan G. Konheim: Computer Security and Cryptography (Wiley, 2007, ISBN: 978-0-471-94783-7)
2. John R. Vacca: Computer and Information Security handbook (Morgan Kaufmann, 2009, 844 pages, ISBN 978-0-12-374354-1)
3. Simon Singh: The code book ISBN 0385495323
4. James M. Stewart, Mike Chapple, Darril Gibson - CISSP (ISC)2 Certified Information Systems Security Professional Official Study Guide, 2015, ISBN 1119042712

5. Tony Hsiang-Chih Hsu - Practical Security Automation and Testing: Tools and techniques for automated security scanning and testing in DevSecOps, 2019, ISBN 1789802024

Suggested readings:

1.Vijay Kumar Velu,Robert Beggs : Mastering Kali Linux for Advanced Penetration Testing: Secure your network with Kali Linux 2019.1 – the ultimate white hat hackers' toolkit, Packt Publishing Ltd, 2019. jan. 30
2.Daniel Regalado, Shon Harris, Allen Harper, Chris Eagle, Jonathan Ness, Branko Spasojevic, Ryan Limm, and Stephen Sims: Gray Hat Hacking: The Ethical Hacker's Handbook
3.Andrew S. Tanenbaum - David J. Wetherall: Számítógép-hálózatok, ISBN:9789635455294
4.Kevin Mitnick: The Art of Invisibility
5. Chris Wysopal: Art of Software Security Testing, The Identifying Software Security Flaws, ISBN 0321304861

Subject name: **Mobile and IoT Application Development**	**Neptun code:** Full time: GEIAL51D-Ma Part time: **Organizational unit:** Information Science
	Type of subject: DSZ5
Responsible Lecturer: Dr. Barabás Péter, associate professor	
Co-Lecturer(s):	
Suggested semester: 4S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 4	**Program:** Full time

Objective and purpose of the subject:

The course is to present the methodology and techniques for development of mobile applications and smart device applications. The course presents the technologies for Arduino and IoT applications

Knowledge: An understanding of the principle of the scientific and engineering methods required for the development of IT applications. A deeper theoretical and practical knowledge in one or more of the following fields within information technology, depending on their specialization: software design, system simulation and modelling, communication networks, mobile and resource constrained applications, computer graphics and image processing, critical and embedded systems, media information technology, IT security, parallel systems, intelligent systems, computational theory, databases.
Skills: Ability to apply and use the acquired knowledge in practice. Ability to use problem-solving techniques for software and application development.
Attitude: Ability to perform development tasks at a professionally high level taking quality into consideration, as well as to ascertain the faultlessness of the developed systems. Openness and commitment to self-education, self-development, to deepen and extend their own knowledge and understanding in the field of natural, engineering and information sciences.
Autonomy and responsibility: Responsibility for complying with and enforcing deadlines. Ability to work in team, as a specialist in a subfield, and lead a team in a responsible way.

Subject description:

Overview of IoT architecture, Methods for development of IoT applications, Arduino-based devices, programming of Arduino-based devices, Arduino panels, alternative devices, power supply, overview of sensor categiories, connection and interface to the different sensors,
Programming o Arduino devices, overview of analoge and digital ports,
programming of th eports, bluetooth and wifi-based communications, external libraries
Architecture of programming of Android devices. Frameworks for mobile programming , programming languages, Googl Firebase databaese, Technologies in mobile programming, data communication between the Arduino and Android devices.

Assignment and requirements of signature (full time):

One classroom test, mini 40% to pass.
One midterm project work
One presenantion about a selected topic in mobile/IoT programmig

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):

written exam:
minimum level: 40%.

Marks: 0 %- 40% unsatisfactory(1) ; 41% - 54% satisfactory(2) ; 55% - 69% averages(3) 70% - 84% good(4) ; 85% - 100% excellent(5) """

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:

1. Barabás Péter: Mobil programozás elektronikus jegyzet, www.iit.uni-miskolc.hu
2. Reto Meier: Professional Android Application Development, ISBN: 978-0-470-34471-2
3. Jamil Y. Khan, Mehmet R. Yuce: Internet of Things Systems and Applications

Suggested readings:

1. Ed Burnette: Hello, Android (4th edition), Introducing Google's Mobile Development Platform, ISBN: 978-1-

3. Korde: oT Experiments

Learn IoT, the Programmer's way68050-037-0

2.G. R. Kanagachidambaresan, R. Maheswar, V. Manikandan, K. Ramakrishnan: Internet of Things in Smart Technologies for Sustainable Urban Development

Subject name: **Applied Machine Learning**	**Neptun code:** Full time: GEIAK631-Ma Part time: **Organizational unit:** Information Science
	Type of subject: DSZ5
Responsible Lecturer: Dr. Dudás László, associate professor	
Co-Lecturer(s):	
Suggested semester: 4S	**Preliminary requirements:**
Classes per week: **Theoretical (full time):** 2 **Practical (full time):** 2 **Theoretical (part time):** **Practical (part time):**	**Requirement type:** exam
Credits: 5	**Program:** Full time

Objective and purpose of the subject:

The aim of the course is to

acquaint students with the essence of the applied machine learning algorithms and one of their representatives, the possibilities of the Microsoft Azure studio. Provide insight into specific areas of applied Artificial Intelligence. It gives an overview of robots and then details the structure, operation and motion control of humanoid robots. Demonstrates particle swarm-based optimization. Describes behavioral robotics, visual systems and speech recognition technologies and learning algorithms of humanoid robots. Provides an overview of brain-machine interfaces. It analyzes the expansion of brain capabilities and the ethical issues of machine intelligence in terms of human competitiveness.

Knowledge: A deeper theoretical and practical knowledge in one or more of the following fields within information technology, depending on their specialization: software design, system simulation and modelling, communication networks, mobile and resource constrained applications, computer graphics and image processing, critical and embedded systems, media information technology, IT security, parallel systems, intelligent systems, computational theory, databases.

Skills: Ability to process new problems and phenomena arising on the boundaries of knowledge of sciences related to information technology.

Attitude: Openness and commitment to self-education, self-development, to deepen and extend their own knowledge and understanding in the field of natural, engineering and information sciences.

Autonomy and responsibility: Ability to develop and operate systems containing operational critical and sensitive information based on their professional competencies.

Subject description:

Short content of the course:

The essence of the applied machine learning algorithms. Features of Microsoft Azure Studio. Robots. Humanoid robots (HR). The future of humanoid robotics. HR control. Application of particle swarm-based optimization to HR motion control. Behavioral robotics. Visual systems, verbal communication and learning of HRs. Multi-agent HRs. Brain-machine interfaces. Brain implants. Developing the ability of the brain. Ethical issues of machine intelligence. Robot rights.

Assignment and requirements of signature (full time):

Two written tests made of the

material published during the year: point limits: 0-36p: 1; 37-45: 2; 46-54: 3; 55-63: 4; 64-72: 5 The condition of the signature is to obtain at least a sufficient grade from each of the two written tests, even at the time of the last weekly replacement.

Assignment and requirements of signature (part time):

Requirement end evaluation of the practical mark/ exam (full time):

Signature is necessary. A recommended

exam mark is available if there are no worse than four between the maeks of the two mid-year tests. If there is only one good mark between the two tests, the exam mark is excellent, otherwise it is good. In the absence of an offered mark, the colloquium will give the grade of the subject. Colloquium point limits: 0-36p: 1; 37-45: 2; 46-54: 3; 55-63: 4; 64-72: 5. Oral correction is possible.

Requirement end evaluation of the practical mark/ exam (part time):

Required readings:

1. Dudás L.: Applied Machine Learning Lecture slides, pdf.
2. Microsoft Azure, https://github.com/mshuedu/microsoft-ai-curriculum/
3. Marco Piastra: Artificial Intelligence- Introduction, 2017. https://vision.unipv.it/AI/00-Introduction.pdf

Suggested readings:

1.D. A. Winter: Biomechanics and motor control of human movement, Wiley-interscience Publication, NewYork, 1990.
2. Jiming Liu, Jianbing Wu (2001) Multi-agent robotic systems, CRC Press, 2001
3. R. Klette, S. Peleg és G. Sommer (2001) Robot vision, Springer, 2001.
4. Particle Swarm Optimisation(PSO), https://www.youtube.com/watch?v=JhgDMAm-imI
5. Microsoft: The Future Computed: Artificial Intelligence and its role in society, Kindle Edition, 2018