University of Debrecen
Faculty of Engineering

Mechatronical Engineering MSc Program

2021

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DEAN'S WELCOME

Welcome to UD's Faculty of Engineering!

The Faculty of Engineering of the University of Debrecen has become an outstanding centre of education and research in the Eastern Hungarian region. Following the footsteps of our predecessors, the academic and administrative staff of the Faculty work hand in hand to make our training programmes and researches meet both national and international standards.

The Faculty of Engineering is one of Hungary's most significant institutions of higher-education, and its 3000 students make it a dominant faculty of the University of Debrecen which - having the most international students, offering the most academic programmes among Hungarian universities and having been classified as a research university, the highest of qualifications - is officially listed among the best universities in the country.

We welcome the most outstanding and inquisitive students of the region with an enthusiastic and professional team of academics and researchers, and a set of laboratories unique in the country. We consciously aspire to develop the quality of education and research further, based on a close cooperation between the Faculty and the industry. Our students enter many prestigious competitions and they are becoming increasingly successful and acclaimed, while our instructors are working on a growing number of national and international projects of basic and applied research.

The Faculty bridges the gap between theory and practice and provides a high-quality theoretical background merged into practice-oriented training based on industrial relations. We do our best to maintain the high prestige of the engineering diplomas awarded by the University of Debrecen and to make sure that the knowledge and achievements of students who graduate from our Faculty continue to be recognised in the labour market.

All things considered, you are kindly advised to read this bulletin which hopefully reflects our endeavours appropriately and provides all the information you need to know about your chosen training programme. We are looking forward to supporting the personal and professional growth of our future engineers.

With the best of wishes for the years to come,

Géza Husi

Dean

HISTORY OF THE UNIVERSITY

The history of Debrecen's higher education dates back to the 16th century. The Calvinist Reformed College, established in 1538, played a central role in education, teaching in the native language and spreading Hungarian culture in the region as well as in the whole country. The College was a sound base for the Hungarian Royal University, founded in 1912. Apart from the three academic faculties (arts, law, theology) a new faculty, the Faculty of Medicine was established, and the University soon became one of the regional citadels of Hungarian higher education. Today, University of Debrecen is classified as "University of National Excellence" and offers the highest number of academic programs in the country, therefore it is considered to be one of the best universities in Hungary. Its reputation is the result of its quality training, research activities and the numerous training programs in different fields of science and engineering in English. With 14 faculties and a student body of almost 30.000, out of which about 3700 are international students, the University of Debrecen is one of the largest higher education institutions in Hungary.

The history of the Faculty of Engineering dates back to 1965, when the Technical College was established. In 1972 it was renamed Ybl Miklós Polytechnic and in 1995 it became part of Kossuth Lajos University. In 2000 the Faculty of Engineering became part of the integrated University of Debrecen.

In 2005 the Bologna System was introduced which supports the competitiveness of qualifications received at the University of Debrecen against universities all over Europe.

The Faculty of Engineering is practice-oriented and develops skills required for the current needs of the national and international labour market. The teaching staff is involved in numerous domestic and international research and design projects. The recently-opened new building wing with its ultra-modern design hosts several lecture halls, seminar rooms and laboratories equipped with the latest technology. Our students are provided with practical knowledge, training and field practice from numerous prestigious domestic and multi-national industry partners. The internship periods are excellent opportunities for students to experience how theory is put into practice at the most renowned industry representatives and become more successful in the labour market of this highly competitive sector. Students learn how to work in the working environment of multi-national companies and adapt to challenges easily. After graduation they will be able to work at a strategic decision-making level, giving priority to efficiency and engineering ethics.

The Faculty of Engineering offers a great variety of BSc, MSc courses and post-graduate training courses tailored to the needs of the rapidly changing world of engineering and focusing on European and international trends. In 2011 the Faculty of Engineering launched engineering trainings in English. In order to optimize the quality of training, the Faculty continuously strives to expand the number of industrial and educational partners at home and abroad.

The Faculty of Engineering has been a pioneer in the introduction of Quality Management System at faculty level to measure and evaluate the efficiency of its education and teaching staff in order to improve the quality of education and training from the feedback received.

The Faculty of Engineering has a vivid student life. There is a film club waiting for movie buffs and the door of the Faculty library is always open. The library is not only the host to the latest technical books, exhibitions and tea afternoons with invited speakers, but students can also purchase theatre and concert tickets from the librarians. The Borsos József Dormitory is also a hub of activities for students.

The increasing number of international students brings cultural and ethnic diversity to the faculty.

Our aim is to aid students to become efficient members of the labour market and enrich the world of engineering in Hungary and abroad with their knowledge and expertise.

ADMINISTRATION UNITS FOR INTERNATIONAL PROGRAMMES

COORDINATING CENTER FOR INTERNATIONAL EDUCATION

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The Coordinating Centre for International Education supports the international degree programmes of the University of Debrecen in giving new students information on admission and entrance exam. It has tasks in promoting and is in charge of tasks like enrolment, study contracts, modifying student status or degree programme, activating student status, modifying students' personal data, requesting and updating student cards, providing certificates for the Immigration Office (for residence permit), issuing student status letters and certificates on credit recognition, concluding health insurance contract and providing Health Insurance Card, helping students with visa process application.

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The International Office has been functioning since 2014 in order to ensure the smooth running of the international degree courses. The office is responsible for student administration (full-time students, full-time transfer students, visiting/Erasmus students), providing certificates for students, considering and accepting requests, solving problems related to course registration, giving information about internship, final exam, thesis, etc.

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Department of Basic Technical Studies
Department of Building Services and Building Engineering
Department of Civil Engineering
Department of Engineering Management and Enterprise
Department of Environmental Engineering
Department of Mechanical Engineering
Department of Mechatronics
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ACADEMIC CALENDAR

General structure of the academic year:

Study period	1st week	Registration*	1 week
	2nd – 7th week	Teaching Block 1	6 weeks
	8th week	1st Drawing Week	1 week
	9th – 14th week	Teaching Block 2	6 weeks
	15th week	2nd Drawing Week	1 week
Exam period	directly after the study period	Exams	7 weeks

*Usually, registration is scheduled for the first week of September in the fall semester, and for the first week of February in the spring semester.

ACADEMIC CALENDAR OF THE FACULTY OF ENGINEERING 2021/2022

Opening ceremony of the academic year	5 September 2021 (Sunday)
Registration week	30 August - 3 September 2021
Revision week (exams in Exam courses may be scheduled during this week)	30 August - 3 September 2021
1st semester study period in MSc and BSc programs	6 September - 10 December 2021 (14 weeks) In case of finalist courses: 6 September 2021 - 5 November 2021 (9 weeks)
Reporting period I (Drawing week I)	18 - 22 October 2021 (4 working days without scheduled lessons, consultation schedule announced previously)
Faculty Conference of Scientific Students' Association	11 November 2021
Reporting period II (Drawing week II)	6-10 December 2021 (5 working days without scheduled lessons, consultation schedule announced previously)
1st semester examination period	13 December 2021 - 28 January 2022 (7 weeks) In case of finalist courses: 8 November - 10 December 2021 (5 weeks)

Thesis (BSc, MSc) submission deadline	As defined by the departments; max. 14 days of the beginning of the final examination period.
Final examination period	As defined by the departments; at least one occasion between 13 December 2021 and 28 January 2022.
Registration week	31 January - 4 February 2022
2nd semester study period in MSc and BSc programs	7 February - 13 May 2022 (14 weeks) In case of finalist courses: 7 February - 8 April 2022 (9 weeks)
Reporting period I (Drawing week I)	21 - 25 March 2022 (5 working days without scheduled lessons, consultation schedule announced previously)
Conferences	30 March – 1 April 2022
Career Days – "Industry Days in Debrecen 2021" (working days without teaching for Mechanical Eng. BSc, Mechanical Eng. MSc, Environmental Eng. MSc, Mechatronics Eng. BSc, Mechatronical Eng. MSc, Civil Eng. BSc students)	30 March – 1 April 2022
Career Days and Exhibition in Building Services Engineering (organised by the Department of Building Services and Building Engineering)	5 May 2022
Reporting period II (Drawing week II)	9 – 13 May 2022 (5 working days without scheduled lessons, consultation schedule announced previously).
2nd semester examination period	16 May - 1 July 2022 (7 weeks) In case of finalist courses: 11 April - 13 May 2022 (5 weeks)
Thesis (BSc, MSc) submission deadline	As defined by the departments; max. 14 days of the beginning of the final examination period.

Final examination period	As defined by the departments; at least one occasion between 16 May and 17 June 2022. The departments shall announce the date of the final examination until 15 February 2022.

THE MECHATRONICAL ENGINEERING MASTER'S PROGRAM

INFORMATION ABOUT THE PROGRAM

Name of master's program:	Mechatronical Engineering Master's Program
Specialisations available:	• Building Mechatronics and Intelligent Buildings Specialisation • Cyber-physical Systems Specialisation
Field, branch:	engineering; mechanical, transport, mechatronics engineering
Level:	graduate , MSc (master)
Qualification:	Mechatronical Engineer
Mode of attendance:	Full-time
Faculty:	Faculty of Engineering
Program coordinator:	Péter Szemes PhD, Associate Professor
Person in charge of the specialisation:	• Building mechatronics and intelligent buildings specialisation: Péter Szemes PhD, associate professor • Cyber-physical systems specialisation: Géza Husi PhD habil, associate professor
Program length:	4 semesters
Credits total:	120 credits

The aim of the programme is to train mechatronical engineers who are capable to integrate engineering with electronics, electrotechnics and computer control in synergetic way at world standard, they are able to work out concepts, to model, design and produce then to maintain and control mechatronic machinery, processes, systems and intelligent machines. They are able to develop and apply new technologies, procedures, materials, to provide managerial and organizational tasks, to be involved and manage in engineering development, research, design and innovation in domestic and international engineering projects in the field of mechatronics. They are prepared to improve their knowledge in doctoral programme.

Specialisations:

Students select specialisation prior to enrolling on the program. Minimum number of applicants per specialisation: 10.

Certain subject groups are common for all Mechatronical Engineering MSc students (Natural Sciences, Economics and Humanities). The subject group "Differentiated professional skills" contains specialized topics and fields.

Professional competences to be acquired

a) knowledge

He/She

- knows and applies natural sciences and engineering theoretical knowledge and cause and effect linkages related to mechatronics engineering in their context.
- has acquired conceptually sound system approach, practice-oriented engineering thinking.
- knows the main features and scope of applied engineering and electrical structural materials.
- has learned the domestic and international standards, specifications that he/she is capable to apply in his/her job and he/she demands them from his/her colleagues too.
- acquired the knowledge of engineering and electrical measuring technology in the field of mechatronics and theory of measurement based on mathematics and informatics.
- acquired communication and information technologies related to his professional field.
- has learned the tools and methods of mathematic modelling and computer simulation of integrated engineering, electrotechnical and control systems in different fields of mechatronics.
- is adept in design, producing, modelling, operating synergic integrated instruments, systems and processes connected to engineering with electronics, electrotechnics and computer control on the bases of his/her theoretical and practical preparedness, his/her knowledge of methodology and practice.
- knows the regulations and tools of carrying out technical documentations.
- knows the organization tools and methods related to management, the laws of profession.

He/she has acquired one or some thematic areas depending on the selected specialisation and at least one specific area among the professional fields below:

- He/she possesses comprehensive knowledge in the field of robot techniques and adaptive mechatronic instruments.
- He/she knows intelligent embedded systems, and has acquired knowledge to design them.
- He/she knows power electronics and motion measurement systems, power supply methods, tools of mechatronic systems.
- He/she knows optomechatronic systems, the principles of their design and development principles, operating and maintenance methods.

- He/she knows biomechatronic systems, the principles of their design, development, operating and maintenance methods.
- He/she knows automotive mechatronic systems the principles of their design, development, operating and maintenance methods.
- He/she knows building mechatronic systems the principles of their design, development, operating and maintenance methods.
- He/she knows manufacturing process automation and methods of robotics systems the principles of their design, development, operating and maintenance methods.
- He/she knows agro-mechatronic methods, the principles of development and operation and methods of maintenance.

b) skills

He/she is able to

- test materials applied in mechatronics engineering by laboratory analysis, to make statistical evaluation about test results, to document and compare test and theoretical results.
- elaborate and systematize the gathered information of maintaining mechatronic systems and processes, to analyse it in different ways, to draw the conclusion.
- design complex mechatronic systems globally on the basis of system approach, process orientation and theory-based thinking.
- adopt his/her global theoretical knowledge to synergistically integrated systems and processes connected to engineering with electronics, electrotechnics and computer control.
- solve irregular problems in his/her complex mechatronic design, to broaden his/her theoretical knowledge individually and to apply his/her new knowledge to practical problem solving.
- broaden the professional knowledge base with his/her own idea.
- design and manage the utilization of engineering, economic, environmental and human resources globally.
- carry out and develop theoretical models of procedures and information technologies applied in design, organization and operation of mechatronic systems and processes.
- insure quality of mechatronic systems, technologies and processes, to conceive measurement and process control tasks in theory and solve in practice.
- review and understand the latest research data in the field of mechatronics and to apply them in his/her job.
- collaborate with the specialists of electrical engineering, mechanical engineering, informatics and life science.
- carry out creative problem treatment and flexible solution of complex problems and to carry out lifelong learning and he/she is committed to variegation and value base.
- be prepared to make publications, presentations and negotiations in his/her professional field in his/her mother tongue and at least in one foreign language.

He/She is committed to health and security culture and health developing.

c) attitude

- On the basis of his/her acquired knowledge he/she has an integrating role in applying engineering sciences (mainly mechanical engineering, electrical engineering, informatics) and in supporting all such scientific fields in which the experts of a professional field require engineering applications and solutions.
- He/She examines the possibilities of research, development and innovation and he/she is about to implement them. He/She is committed to broaden mechatronic engineering field with new knowledge and scientific achievements.
- He/She aims to carry out his/her tasks on the basis of system approach and process oriented complex thinking.
- He/She aims to enforce the requirements of maintenance and energy efficiency.
- He/She aims to organize and carry out his/her tasks with a high level of proficiency individually or in work teams.
- He/She aims to develop his/her professional competence.
- He/She aims to self-development, self-improvement with active, individual and autonomous learning.
- He/She is committed to high-level, qualitative work and aims to convey this approach to his/her colleagues.
- He/She keeps the engineering, economic and legal regulations and the codes of engineering ethics.
- His/Her professional work serves the requirements of quality, consumer protection, product liability.
- He/She implements the fundamental specifications of environmental protection, workplace health and security.
- He/She is quite open-minded, acquired and applies the principle of equal access.

d) autonomy and responsibility

- He/She shares his/her acquired knowledge and experiences with the colleagues of His/her professional field in informal or formal way.
- He/She evaluates the job of his/her subordinates, provides them with his/her critical notes to promote their professional development.
- He/She will take action for problem solving.
- He/She takes initiative role in solving engineering problems.
- He/She educates his/her colleagues and subordinates on responsible and ethic occupation.
- He/She has a responsibility for maintenance, workplace health and security culture and environmental consciousness.
- He/She makes independent decision thoroughly with the consultation of other professional areas (mainly in the field of law, economy, energetics, electrical engineering, informatics and medicine) and he/she takes responsible for them.

- In strategic decision-making situations requiring new, complex approach and in unexpected real-life situations he/she aims to make decisions in consideration of laws and ethic norms.
- In his/her decision making he/she considers environmental protection, quality, consumer protection, product liability, the principle of equal access and its application, workplace health and security, the regulations of engineering, economy and law and the codes of engineering ethics.

COMPLETION OF THE ACADEMIC PROGRAM

Credit System

Majors in the Hungarian Education System have generally been instituted and ruled by the Act of Parliament under the Higher Education Act. The higher education system meets the qualifications of the Bologna Process that defines the qualifications in terms of learning outcomes, statements of what students know and can do on completing their degrees. In describing the cycles, the framework uses the European Credit Transfer and Accumulation System (ECTS).

ECTS was developed as an instrument of improving academic recognition throughout the European Universities by means of effective and general mechanisms. ECTS serves as a model of academic recognition, as it provides greater transparency of study programmes and student achievement. ECTS in no way regulates the content, structure and/or equivalence of study programmes.

Regarding each major, the Higher Education Act prescribes which professional fields define a certain training program. It contains the proportion of the subject groups: natural sciences, economics and humanities, subject-related subjects and differentiated field-specific subjects.

The following professional fields define the Mechatronical Engineering MSc training:

Natural Sciences: 20-35 credits,

Economics and Humanities: 10-20 credits,

Field-specific professional skills for mechatronical engineers: 15-35 credits.

The specialisation provided by the training institute including thesis comprises 40-60 credits in the complete master program.

Minimum of credit points assigned to optional subjects: 6

Credit points assigned to thesis: 15

Credits total: 120

Guideline (List of Subjects/Semesters)

The total number of credit points (120) of the training program can be obtained by completing the subjects of the curriculum. There is a certain degree of freedom in the order students can complete the subjects. However, it is recommended that the suggested order be followed because some subjects can only be taken after the completion of the prerequisite subject(s), and/or can be the prerequisites for other subjects.

The list of subjects you have to complete in the semesters according to the model curriculum of Mechatronical Engineering MSc programme, **Building Mechatronics and Intelligent Buildings Specialisation**.

1st semester	2nd semester
Mathematics IV	Mathematics V
Spatial Mechanisms and Dynamical Systems	Materials Science
Economical, Financial and Investment Decisions for engineers	Engineering Leadership and Organizational Methods
Electronics II	Digital and Servo Drives
Control theory	Building Management Systems
	Building Physics
3rd semester	4th semester
Embedded Systems	Building Automation
Image Processing	Project of Building Mechatronics and Smart Spaces II
Building Service Systems and Elements	MSc Diploma Thesis II
Project of Building Mechatronics and Smart Spaces I	
MSc Diploma Thesis I	

About the prerequisites of each subject please read the chapter “Course Descriptions”!

The list of subjects you have to complete in the semesters according to the model curriculum of Mechatronical Engineering MSc programme, **Cyber-physical Systems specialisation**:

1st semester	2nd semester
Mathematics IV	Mathematics V
Spatial Mechanisms and Dynamical Systems	Materials Science
Economical, Financial and Investment Decisions for Engineers	Engineering Leadership and Organizational Methods
Electronics II	Digital and Servo Drives
Control Theory	Building Management Systems
	Cyber Security
	XX in the Loop Systems
3rd semester	4th semester

Embedded Systems

Image Processing

Modelling Robots

Project of Cyber Physics I

MSc Diploma Thesis I

Components of Cyber-Physical Systems

Project of Cyber Physics II

MSc Diploma Thesis II

Work and Fire Safety Course

According to the Rules and Regulations of University of Debrecen students have to complete the online course for work and fire safety in the first semester of their studies. Registration for the course and completion are necessary for graduation. For MSc students the course is only necessary only if BSc diploma has been awarded outside of the University of Debrecen.

Subject code: MUNKAVEDELEM

Link: http://munkavedelem.unideb.hu/1_eves-ENg.htm

Login: Neptun ID plus password

Students have to read the material until the end to get the signature on Neptun for the completion of the course.

Internship

Students majoring in the Mechatronical Engineering MSc have to carry out a 4-week long internship involved in the model curriculum. The internship course must be signed up for previously via the NEPTUN study registration system in the spring semester (2nd semester). Its execution is the criteria requirement of getting the leaving certificate (absolutorium).

Physical Education

According to the Rules and Regulations of University of Debrecen a student has to complete Physical Education course at least in one semester during his/her Master's training. Our University offers a wide range of facilities to complete them. Further information is available from the Sport Centre of the University, its website: http://sportsci.unideb.hu.

Optional Courses

According to the Rules and Regulations of University of Debrecen a student has to complete elective courses during his/her MSc training. These elective courses are opened by the Departments at the Faculty of Engineering at the beginning of the actual semester. You can find the list of the actual semester under "Current Students" >" Useful Information about your Study" >" Optional subjects".

A student can also select optional courses from other faculties of University of Debrecen to complete.

In the Mechatronical Engineering MSc programme you have to gain at least 6 credits with completing elective subjects.

Pre-degree Certification

The Faculty fills in a pre-degree certificate (absolutorium) for students as a completion of their studies in master training. An absulotorium is filled in for a student who fulfilled all the requirements of the curriculum according to Article 10 in the Rules and Regulations of University of Debrecen, - except thesis making -, including having gained all the credits, completed the requirements of physical education and vocational practice. An absolutorium without qualification and evaluation certifies that the student fulfilled all requirements of academic studies, exams and physical education. A student obtained the pre-degree certificate can hand in a thesis and take a final exam.

Thesis

A thesis is adequate to the training and the selected specialisation with its written form. It is creative elaboration of a professional task (scientific, engineering, design, development, research or research development) made with scientific approach. By solving the task, the student relies on his/her studies using national and international literature under the guidance of an internal and as appropriate an external supervisor (referee). By solving the task the mechatronics engineering student certifies that he/she is capable to apply the acquired knowledge in practice and to summarize the completed

work and its results in professional way, to solve the tasks related to his/her topic creatively and to complete individual professional work.

A student in master program has to make a thesis as a prerequisite of the final exam. The requirements of the thesis content, the general aspects of evaluation and the number of credits assigned to the thesis are determined by the requirements of the program. In mechatronical engineering program the credits assigned to the thesis is 30.

The latest that thesis topics are announced by the departments for the students is the end of week 4 of the study period of the last semester. A thesis topic can be suggested by the student as well and the head of department assigned shall decides on its acceptance. The conditions on the acceptance of thesis as National Conference of Scientific Students' Association (hereinafter NCSSA) topic are specified by the Faculty. The NCSSA work is supposed to meet the requirements in form and content for thesis, and the evaluation committee of NCSSA faculty conference approves its development to a thesis.

The formal requirements of a thesis are determined by the Department of Electrical Engineering and Mechatronics, they are announced in written form at the same time as the topics are issued.

Thesis writing is controlled by a supervisor (internal) and helped by a referee (external) approved by the Department.

The faculty academic calendar issued by the Vice-Rector for Education sets the thesis submission deadline, for want of this the deadline is the 14th day 12 noon before the first day of the final exam.

A thesis is evaluated by a referee (internal or external) and it is evaluated and qualified individually by each department. The Head of the Department of Electrical Engineering and Mechatronics makes suggestion on its qualification to the Final Exam Board.

If thesis is evaluated with a fail mark by the referee and the department the student is not allowed to take the final exam and is supposed to prepare a new or modified thesis. The student has to be informed about it. Conditions on resubmitting the thesis are defined by the program coordinator.

Final exam

A final exam can be taken in active student status in the forthcoming exam period after gaining the pre-degree certificate then after termination of student status in any exam period within two years according to the valid education requirements. After the fifth year of the termination of student status the candidate is not allowed to take the final exam. A student who has outstanding charges is not allowed to take the final exam. Students who obtained a pre-degree certificate until 1 September 2016 can take the final exam until 1 September 2018.

The final exam in mechatronical engineering master program goes on according to the traditions of engineering.

Students having obtained the pre-degree certificate will finish their studies in Mechatronical Engineering master program by taking the final exam. Final exam is an evaluation and a control of the acquired knowledge (skills) in which a candidate has to reveal that he/she is able to apply the acquired knowledge. A final exam can be taken in

active student status in the forthcoming exam period after gaining the pre-degree certificate. The Department announce the final exam dates every year, one in January and another in June. A final exam must be taken in front of a committee only on the set dates. If a student cannot pass the final exam during his/her active student status, then he/she can take it after termination of student status on any final exam date in any exam period according to the valid final exam and education requirements. After the fifth year of the termination of student status the candidate is not allowed to take the final exam. Only students who do not have outstanding charges are allowed to take the final exam.

The Final exam consists of two parts:

To elaborate tasks in writing (the time available for the tasks is 3 hours) topic: theories and methods of Mechatronics (Questions are drawn up from the followings: spatial mechanism and dynamic systems, electronics, embedded systems, and all the subjects of the specialisation)

To answer questions on the knowledge related to the thesis topic after preparation. Topics are appointed after submitting the thesis (3to5 topics).

To defend the submitted thesis (to give a presentation on the thesis, to answer questions and notes related to the thesis)

A final exam can be started if the candidate can be submitted to the final exam on the basis of definite opinion of the referees. Its parts can be held separately on different days (e.g.: first and second parts on one day and third part on another day).

The parts of the final exam are evaluated on a five-point scale by members with voting rights in the Final Exam Board. The final grade for the final exam will be decided on by voting in a closed sitting after the final exam, then in case of equal votes the committee chair will take the decision. A candidate receives marks on his/her Thesis and the separated part of the final exam from the final Exam board. Final exam results will be announced by the committee chair. Results of the final exam and thesis defence will be announced at the end of the given exam day (when all candidates have finished the final exam and thesis defence on the given day). A note of the final exam will be taken.

Improving failed final exam

If the first, second or third part of the final exam is evaluated with a fail mark the failed part has to be retaken according to the existing rules of the university. The ensuing final exam period is the soonest that the re-sit is allowed.

Final exam board

The Committee (Final Examination Board) consists of a Committee chair, a Committee vice-chairs, members and questioners. The Committee chair selected from the acknowledged external experts of the professional field is called upon and mandated by the dean with the consent of the Faculty Council. They are selected from the acknowledged internal and external experts of the professional field. Traditionally, it is the chair, and in case of his/her absence or indisposition, the vice-chair who will be called

upon, as well. The committee consists of – besides the chair – at least one member (a professor, an associate professor or college professor) and at least two questioners (instructors: college associate professors, college senior lecturers, assistant lecturers, master lecturers). In controversial cases the chair makes the decision. The mandate of a Final Examination Board lasts for three years. The division of the candidates to the mandatory final exam board is announced by the Registry Office.

The order of subject follows the subject list in the model curriculum above.

Subject group “Natural Sciences” (for both specialisations)

Mathematics IV

Code: MK5MAT4A04RX17-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 1st spring semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

This course aims to make students familiar with basics of probability, reliability theory and evaluation. They solve tasks in regression analysis. They learn about ANOVA, Markov chain and other significant models that can be applied during their master studies.

Literature:

Compulsory:

- Montgomery, D. C., Runger, G. C., Applied Statistics and Probability for Engineers, John Wiley & Sons Inc., 2003
- Soong, T. T., Fundamentals of probability and statistics for engineers, John Wiley & Sons, Inc., 2004
- DeCoursey, W. J., Statistics and Probability for Engineering Applications with Microsoft® Excel, Newnes, 2003
- Allen, T. T., Introduction to Engineering Statistics and Six Sigma, Springer, 2006
- Pham, Hoang (Ed.), Springer Handbook of Engineering Statistics, Springer, 2006, ISBN 978-1-85233-806-0
- NIST/SEMATECH e-Handbook of Statistical Methods, http://www.itl.nist.gov/div898/handbook/
- R.H. Shumway & D.S. Stoffer, Time Series Analysis and Applications - Using the R Statistical Package, Free dog publishing, 2017
- Shumway, R. H., Stoffer, D. S., Time Series Analysis and Its Applications, Springer 2011
- Montgomery, D. C., Introduction to Time Series, Analysis and Forecasting, John Wiley & Sons. 2008

Schedule

1st week Registration week	
2nd week: **Lecture:** Survey of the basics of probability theory and statistics. **Practice:** Calculation of probability.	3rd week: **Lecture:** Basics of reliability theory, system reliability evaluation. **Practice:** Random variables.
4th week: **Lecture:** Point estimation, interval estimation. Confidence interval. **Practice:** Point and interval estimation.	5th week: **Lecture:** Hypothesis testing (probability, mean, standard deviation), normality test. **Practice:** Hypothesis testing.
6th week: **Lecture:** One and two-factor ANOVA, gage R&R (repeatability and reproducibility) study. **Practice:** ANOVA	7th week: **Lecture:** Linear and non-linear regression models. **Practice:** Regression analysis.
8th week: 1st drawing week, mid-term test	
9th week: **Lecture:** Time series characteristics. **Practice:** Time series characteristics.	10th week: **Lecture:** Time series regression. **Practice:** Time series regression.
11th week: **Lecture:** ARIMA Models **Practice:** ARIMA Models	12th week: **Lecture:** Spectral analysis and filtering **Practice:** Spectral analysis and filtering
13th week: **Lecture:** Markov chain, discrete and continuous time Markov chains. **Practice:** Time series. Markov chain.	14th week: **Lecture:** Birth-death processes mass-service models, queuing. **Practice:** Birth-death processes mass-service models, queuing.
15th week: 2nd drawing week, end-term test	

Requirements

A, for a signature:

Participation at practice classes is compulsory. Students must attend practice classes and may not miss more than three occasions during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't take part in any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor.

During the semester there are two tests: the mid-term test on the 7th week and the end-term test on the 15th week. Students must sit for the tests.

B, for a grade:

During the semester there will be two tests, the students have to complete them at acceptable level.

Mathematics V

Code: MK5MAT5A04RX17-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 1st fall semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

This course aims to make students familiar with direction field and differential equations. They solve tasks in equation systems. They learn about non-linear and linear differential equations that can be applied during their master studies.

Literature:

Compulsory:

- Greenberg, M. D., Advanced Engineering Mathematics, New Jersey, Prentice Hall, 1998.
- Polyanin, A.D., Manzhirov, A.V., Handbook of Mathematics for Engineers and Scientists, Chapman & Hall, 2007.
- Burghes, D. N., Modelling with Differential Equations, John Wiley & Sons, 1981.
- Logan, J. D., Applied Partial differential equations, New York, Springer, 2004.
- Chapra, S. C., Numerical Methods for Engineers, Mc Graw Hill, 2006.
- Dyke, P., An Introduction to Laplace Transforms and Fourier Series, Springer, 2014

Schedule

1st week Registration week	
2nd week:	3rd week:

Lecture: Modeling with differential equations. Initial value and boundary value problems.	**Lecture:** Direction field. Euler method, Runge-Kutta method. Autonomous systems, phase plane.
Practice: Modeling with differential equations.	**Practice:** Modeling with differential equations.
4th week:	5th week:
Lecture: Differential equations and equation systems. Existence and uniqueness theorems.	**Lecture:** Some types of non-linear differential equations.
Practice: Euler method, Runge-Kutta method.	**Practice:** Some types of non-linear differential equations.
6th week:	7th week:
Lecture: Linear differential equations and equation systems.	**Lecture:** Solution methods of linear differential equations.
Practice: Solution methods of linear differential equations.	**Practice:** Solution methods of linear differential equations.
8th week: 1st drawing week, mid-term test	
9th week:	10th week:
Lecture: Fourier integral, Fourier transform, z-transform.	**Lecture:** Laplace-transform and applications.
Practice: Fourier transform, z-transform.	**Practice:** Laplace-transform.
11th week:	12th week:
Lecture: Numerical methods: Picard-iteration, power series solutions.	**Lecture:** Systems of linear differential equations. Systems of linear differential equations with constant coefficients, solution methods.
Practice: Numerical methods.	**Practice:** Systems of linear differential equations.
13th week:	14th week:
Lecture: Autonomous systems, critical points, stability.	**Lecture:** Partial differential equations. Examples.
Practice: Autonomous systems, critical points, stability.	**Practice:** Partial differential equations. Examples.
15th week: 2nd drawing week, end-term test	

Requirements

A, for a signature:

Participation at practice classes is compulsory. Students must attend practice classes and may not miss more than three occasions during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't take part in any practice class with another group. Attendance at practice classes will be

recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor.

During the semester there are two tests: the mid-term test on the 7th week and the end-term test on the 15th week. Students must sit for the tests.

B, for a grade:

During the semester there will be two tests, the students have to complete them at acceptable level.

Spatial Mechanisms and Dynamical Systems

Code: MK5DINRG06RX17-EN

ECTS Credit Points: 6

Evaluation: exam

Year, Semester: 1st spring semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 4+2

Topics:

Linear and nonlinear dynamical system analysis in time-domain. Differential equations. Duhamel principle and transfer function. Convolution. Typical signals for system analysis. Harmonic functions as input signals for dynamical systems. Ergodic excitations. Dirac and Heaviside functions. Transfer characteristics. Stochastic signals and environmental vibrations on dynamical systems. Autocorrelation function and cross-correlation function. Hamilton-Jacobi equations. Virtual work principle. D'Alembert principle. Classification of the constraints. First order Lagrange equation.

Second order Lagrange equation. Holonomic and nonholonomic constraints.

Generalization of Lagrange principle for 1-DOF and higher DOF dynamic systems.

Analysis of linear systems in complex frequency domain. Integral transformations for analysis of mass-spring-damper systems. Laplace transform for mathematical solution of DEs and for analysis of mass-spring-damper systems. Asimptotic principles. Stability of linear systems. Nyquist criteria Routh-Hurwitz criteria.

Analysis of linear systems in frequency domain. Fourier integral. Fourier transform. Analysis of signals and systems by Fourier transform. Bending vibrations of power transmission systems. Simulation in Matlab, Labview and Simulink. Continium vibrations. Torsional vibrations of shafts. Laval-rotor. Rayleigh quotient iteration, Stodola (convergence), Rayleigh's principle, Dunkerley's estimate. Longitudinal and torsional vibrations of prismatic bars.

Vibration of continuum bars The Sturm-Liouville task and relationship with the standing wave solution. Longitudinal vibrations of prismatic beams.

Spatial mechanisms. Robot manipulators. Kinematics and dynamics of wrist movements, kinematic chains, Lagrange equations, TTT / RTT / RRR work spaces. Robotics in machine industry.

Spatial mechanisms direct and inverse kinematic and dynamical characterization tasks, Lagrange equations. Denavit-Hartenberg principle. Grashof principle and Roberts principle for spatial mechanisms. Simscape simulation for spatial mechanisms.

Vibration analysis of cutting machines in manufacturing technology, spindles, rotors as special dynamic systems. Simulations of dynamic systems in Matlab Simulink. Vibration isolation systems, calculation, vibration reduction, critical frequency, resonance, environmental noise and vibration reduction methods.

Literature:

Compulsory:

- Allan G. Piersol, Thomas L.Paez: Harris's Shock and Vibration Handbook, Sixth Edition, McGrraw-Hill,2010. ISBN 978-0-07-163343-7
- S. Graham Kelly: Mechanical Vibrations Theory and Applications, University of Akron, 2012. ISBN -13: 978-1-4390-6214-2
- Harold Josephs- Ronald J. Huston: Dynamics of mechanical systems. 5th Edition, CRC Press Inc., 2006. ISBN 0-8439-0593-4
- Parasuram Harihara, Dara W. Childs: Solving Problems in Dynamics and Vibrations Using MATLAB, Dept. of Mechanical Engineering, Texas, A & M University, 2014
- Eugene Avallone: Standard Handbook for Mechanical Engineers, Eleventh Edition, McGrraw-Hill,2010. ISBN-13: 978-0-07-142867-5

Schedule

1st week Registration week	
2nd week: **Lecture:** Mathematical basics. Matrices. Tensors. Diff. equations. Eigenvalues. Numerical methods. **Practice:** Matlab applications.	**3rd week:** **Lecture:** Linear and nonlinear dynamic system analysis in time-domain. Differential equations. Duhamel principle and transfer function. Convolution. Typical signals for system analysis. Harmonic functions as input signals for dynamical systems. Ergodic excitations. **Practice:** Differential equations and calculations.
4th week: **Lecture:** Dirac and Heaviside functions. Transfer characteristics. Stochastic signals and environmental vibrations on dynamical systems. Autocorrelation function and cross-correlation function **Practice:**	**5th week:** **Lecture:** Hamilton-Jacobi equations. Virtual work principle. D'Alembert principle. Classification of the constraints. First order Lagrange equation. Second order Lagrange equation. Holonomic and nonholonomic constraints.

Labview and Matlab signal generation for system analysis.	**Practice:** Lagrange equations for dynamical systems. Solution of Diff. equations.
6th week:	**7th week:**
Lecture: Generalization of Lagrange principle for 1-DOF and higher DOF dynamical systems. **Practice:** Examples and calculations of 1-DOF and higher DOF mass-damper-spring systems.	**Lecture:** Analysis of linear systems in complex frequency domain. Integral transformations for analysis of mass-spring-damper systems. Laplace transform for mathematical solution of DEs and for analysis of mass-spring-damper systems. **Practice:** Laplace transform applications for dynamical systems.
8th week: 1st drawing week	
9th week:	**10th week:**
Lecture: Analysis of linear systems in frequency domain. Fourier integral. Fourier transform. Analysis of signals and systems by Fourier transform. Stability of linear systems. Nyquist criteria Routh-Hurwitz criteria. **Practice:** Analysis of harmonic signals with Fourier transform.	**Lecture:** Bending vibrations of power transmission systems. Laval-rotor. Rayleigh quotient iteration, Stodola convergence, Rayleigh's principle, Dunkerley's estimate. Longitudinal and torsional vibrations of prismatic bars. Vibration of continuum bars The Sturm-Liouville task. **Practice:** Simulation in Matlab, Labview and Simulink.
11th week:	**12th week:**
Lecture: Spatial mechanisms. Robot manipulators. Kinematics and dynamics of wrist movements, kinematic chains, Lagrange equations, TTT / RTT / RRR work spaces. Robotics in machine industry. Spatial mechanisms direct and inverse kinematic and dynamic characterization tasks, Lagrange equations. **Practice:** Simscape simulation for spatial mechanisms.	**Lecture:** Spatial mechanisms Denavit-Hartenberg principle. Grashof principle and Roberts principle for spatial mechanisms. **Practice:** Simulation in Simulink and Labview.
13th week:	**14th week:**
Lecture: Vibration analysis of cutting machines in manufacturing technology, spindles, rotors as special dynamic systems. **Practice:** Simulations of dynamic systems in Matlab Simulink.	**Lecture:** Vibration isolation systems, calculation, vibration reduction, critical frequency, resonance, environmental noise and vibration reduction methods. **Practice:** Passive and active vibration isolation system calculations. Vibration measurement and methods for mitigation.

15th week: 2nd drawing week, End-term test

Requirements

A, for a signature:

Participation at practice classes is compulsory. Students must attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't take part in any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor.

During the semester there are two tests: the mid-term test is on the 8th week and the end-term test is on the 15th week. Students must sit for the tests.

B, for grade:

The course ends in **exam grade**. The grade for the test is given according to the following (score/grade): 0-59 % = fail (1); 60-69 % = pass (2); 70-79 % = satisfactory (3); 80-89 % = good (4); 90-100 % = excellent (5).

Materials Science

Code: MK5ANTUG06RX17-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Year, Semester: 1st fall semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

The aim of the course is to extend the material science knowledge taught in the undergraduate course, through the presentation of special materials and its tangible analysis. Additionally, students can get closer to medical materials, which are currently being developed at a remarkable scale.

Literature:

Compulsory:

- Chawla, Krishan K. Composite Materials Science and Engineering 3rd ed. Springer 2012
- Nicolais, Luigi; Meo, Michele; Milella, Eva: Composite Materials: A Vision for the Future, 2011 Springer Verlag

- C.P. Poole, F.J. Owens: Introduction to nanotechnology, Wiley Interscience, 2003

Schedule

1st week Registration week	
2nd week: Lecture: Overview of the groups of substances and presentation of the latest material science results Practice: Preparation of a metallographic sample for semester task	3rd week: Lecture: Composites I. - overview and presentation of composite materials Practice: Preparation of a metallographic sample for semester task
4th week: Lecture: Composites II. - composite manufacturing technology Practice: Charpy impact test for semester task	5th week: Lecture: Composite III. - Aerospace industrial and space applications Practice: Charpy impact test for semester task
6th week: Lecture: Composite IV. - Special composites, nano and bio composites Practice: Charpy impact test for semester task	7th week: Lecture: Polymer I. - Overview of Industrial Polymers, Production Technology Practice: Charpy impact test for semester task
8th week: 1st drawing week	
9th week: Lecture: Polymer II. - Certification procedures for industrial polymers, case studies Practice: Charpy impact test for semester task	10th week: Lecture: Ceramics I. - Overview Practice: Charpy impact test for semester task
11th week: Lecture: Ceramics II. - Production technology Practice: Measurement of toughness, toughness and theoretical strength calculation of the ceramic coating of the neural implant.	12th week: Lecture: Ceramics III. - Qualification procedures Practice: Measurement of toughness, toughness and theoretical strength calculation of the ceramic coating of the neural implant.
13th week: Lecture: Biocompatible materials I. Practice: Microscopic analysis of human implants	14th week: Lecture: Biocompatible materials II. Practice: Microscopic analysis of human implants
15th week: 2nd drawing week	

Requirements

A, for a signature:

Participation at practice classes is compulsory. Students must attend practice classes and may not miss more than three practice classes during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't take part in any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor.

During the semester there are two tests: the mid-term test is on the 8th week and the end-term test is on the 15th week. Students must sit for the tests.

B, for grade:

The course ends in a mid-semester grade based on the average grade of the two tests.

The minimum requirement of the mid-term and the end-term test is 60% separately. The grade for each test is given according to the following (score/grade): 0-59 % = fail (1); 60-69 % = pass (2); 70-79 % = satisfactory (3); 80-89 % = good (4); 90-100 % = excellent (5). If the score of any test is below 60, the student once can take a retake test of the whole semester material.

Subject group "Economics and Humanities" (for both specialisations)

Economic, Financial and Investment Decisions for Engineers

Code: MK5BERUM06XX17-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Year, Semester: 1st spring semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+4

Topics:

This course is intended to introduce students to the main concepts and theories about economics, financial, investment analysis and business/corporate performance measurement so that students are able to make comparative analysis.

The course focuses on the theory and application of the following:

The time value of money. Calculating future value and present value. Compound interest and present value. Calculating the internal rate of return (IRR). Making investment

decision with the net present value rule. Profitability index. Equivalent annual cost. General economic and social environment, sustainable development, corporate social responsibility. Valuing bonds (duration, bond volatility). The value of common stocks. Investment – externalities. Options, option strategies. Project analysis. Economic and environmental performance indicators.

Literature:

Compulsory:

- Brealey, R. A. - Myers, S. C. – Allen, F (2014): Principles of Corporate Finances. 11th Edition, McGraw-Hill/Irwin, 2014. ISBN-13: 9780077151560.
- T. Kiss Judit (2016): Introduction to Corporate Financial Decisions for Engineers and Engineering Managers. Dupress, University of Debrecen. Accepted – ISBN: 978-963-318-583 4.

Recommended:

- Scott Besley - Eugene F. Brigham (2011): Principles of Finance. Cengage Learning, 2011 (South Western). ISBN: 1111527369, 9781111527365
- Correia, C. – Flynn, D. K. - Besley – Ulian, E. – Wormald, M. (2012): Financial Management. 6th edition. Juta and Company Ltd. ISBN: 0702171573, 9780702171574.
- E.R. Yescombe (2014): Principles of Project Finance second edition Yescombe ConsultingLtd. London 2014.
- Stefano Gatti (2013): Project Finance in Theory and Practice Designing, structuring and financing private and public projects ELSEVIER INC.

Schedule

1st week Registration week	
2nd week:	3rd week:
Lecture: Goals and governance of the firm; The investment trade-off, investment and financing decision. Shareholders, Stakeholders, Agency problems. Value chain and comparative analysis.	Lecture: Future value and present value calculation (continuous compounding, frequency of payment, annuity (ordinary and annuity due). Valuing Cash Flows in Several Periods.
Practice: Teamwork problems: Compound interest and frequency of payment.	Practice: Teamwork problems: Future value calculation I - Future value of annuity, compound interest.
4th week:	5th week:
Lecture: The present value of an investment opportunity, Net Present Value. The opportunity cost of capital. Multiple cash flows (expenditures – costs – revenues). Profitability index.	Lecture: Valuing annuities (Future and present value of an annuity). Types of annuities. The payback rule; The discounted payback rule. Shortcomings of payback period.

Practice: Teamwork problems: Future value calculation II – Expenditures and revenues. Present value of cash flows.	**Practice:** Teamwork problems: The relationship between future and present value of an annuity. Discounted payback period.
6th week: **Lecture:** Internal rate of return (IRR). IRR rule, shortcomings of internal rate of return. Comparative analysis of technical investments, case studies. Sensitivity analysis (inflation rate, technological change). **Practice:** Teamwork problems/computer related problems: IRR rule, shortcomings of internal rate of return.	**7th week:** **Lecture:** Choosing between short- and long-lived equipment. Investment with identical life-times and investments with different life-times. Equivalent annual cost and equivalent annual benefit. Inflation and the opportunity cost. Equivalent annual cash-flow and technological change. **Practice:** Teamwork problems: Equivalent annual cost and equivalent annual benefit. Inflation, technological change.
8th week: 1st drawing week	
9th week: **Lecture:** Mutually exclusive projects. Investment timing. Project analysis, case studies. **Practice:** Mid-term test I.	**10th week:** **Lecture:** Making investment decisions. Project Analysis. Corporate strategies and performance measurement. The role of human capital, and innovation. **Practice:** Teamwork problems: Mutually exclusive projects. Project Analysis.
11th week: **Lecture:** General economic and social environment, sustainable development, corporate social responsibility. Private, social and global costs. **Practice:** Teamwork problems: Case study analysis.	**12th week:** **Lecture:** Valuing Bonds. Types of Bonds. Perpetuities, growing perpetuities. Duration, bond volatility. Bond's yield to maturity. The relationship between coupon rate and interest rate. **Practice:** Teamwork problems: The theoretical value of bonds. Perpetuity and growing perpetuity.
13th week: **Lecture:** The value of Common Stocks. The determinants of stock prices. Return on equity - ROE. Net present value of growth opportunities. Expected dividends, dividend yield, price-earnings ratio, ROE, plowback ratio. **Practice:** Teamwork problems: The theoretical value of stock. Expected	**14th week:** **Lecture:** Options (Calls, puts, and Shares). Strike price. Position and profit diagrams. Put-call parity. Determinants of the option values. Buying call option, buying put options, selling call options, selling put options. **Practice:** Teamwork problems and computer related problems: Position and profit diagrams. Option strategies.

dividends, dividend yield, price-earnings ratio, ROE, plowback ratio	

15th week: 2nd drawing week

A, for a signature:

Participation at practice classes is compulsory. Students must attend practice classes and may not miss more than three occasions during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't take part in any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor.

During the semester there are two tests: the mid-term test on the 7th week and the end-term test on the 15th week. Students must sit for the tests.

B, for a grade:

The course ends in **mid-semester grade** based on the average grade of the two tests.

The minimum requirement for the mid-term and end-term tests is 60%. Based on the score of the tests separately, the grade for the tests is given according to the following:

0-59 % = fail (1); 60-69 % = pass (2); 70-79 % = satisfactory (3); 80-89 % = good (4); 90-100 % = excellent (5)

If the score of any test is below 60, the student once can take a retake test covering the whole semester material.

An offered grade: It may be offered for the students if the average of the mid-term test, end-term tests and the teamwork is at least good (4). The offered grade is the average of them.

Engineering Leadership and Organizational Methods

Code: MK5VEZMMO4XX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 1st fall semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

The aim of the course is to provide students with a comprehensive picture of the organization's operations and the related management and organizational roles and tasks, the presentation of business strategies, decision models, the presentation of typical engineering leadership roles, tasks, situations and tools. Introducing students with the widely-used organizational methods that can be successfully applied in the management and management of organizational processes.

Literature:

Compulsory:

- Nick Milton, Patrick Lambe: The Knowledge Manager's Handbook, Kogen Page, London, 2016
- Ranulfo P. Payos, Ernesto G. Espinosa, Orlando S. Zorilla: Organization and Management, K12, 2016
- Ramani S: Improving Business Performance: A Project Portfolio Management Approach, CRC Press, 2016
- Ronald Bennett, Elaine Millam: Leadership for Engineers: The Magic of Mindset (Basic Engineering Series and Tools) 1st Edition, 2012

Schedule

1st week Registration week	
2nd week: Lecture: Management methods Practice: Assessing leadership style through personality tests and situational tasks	3rd week: Lecture: Coordination of task, competence, power and responsibility Practice: In connection with the project, elaborate a complex task based on the job, power and competence
4th week: Lecture: Motivation theories Practice: Case studies and motivational tests to reveal students' self-motivation and motivational tools	5th week: Lecture: Psychology in leadership Practice: Use the psychology methodology to use situations and case studies
6th week: Lecture: Career Plan Practice: Developing specific career plans	7th week: Lecture: Strategy Practice: Develop a specific strategic plan
8th week: 1st drawing week	
9th week: Lecture: Basic concepts of organization Practice: Case study	10th week: Lecture: Methods for determining process characteristics Practice: Analysis of corporate processes
11th week: Lecture: Modern organizational trends	12th week: Lecture: The lean approach

Practice: Use of organization methods	**Practice:** Case study
13th week:	**14th week:**
Lecture: Specific Group Method	**Lecture:** The essence of new techniques
Practice: Brain storming, Delphi method	**Practice:** Case study
15th week: 2nd drawing week	

Requirements

A, for a signature:

Participation at lectures is compulsory. Students must attend lectures and may not miss more than three of them during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at lectures will be recorded by the lecturer. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed lectures must be made up for at a later date, being discussed with the tutor.

Students have to write two midterm tests during the semester. The first (40 points max) in the 8th, the second (40 points max) in the 14th week. At the end of the semester everybody will get a seminar grade on the basis of the following: (score/grade): 0-39 = fail; 40-50 = pass (2); 51-60 = satisfactory (3); 61-70 = good (4); 71-80 = excellent (5).

If somebody fails, then he has to write both tests in the 1st week of the exam period again. If the result is 40 points (50%) or better, then he can take an exam. If somebody has to repeat his midterm tests, then his seminar grade can't be better than (2).

There will be homework from week to week. Only students who have handed in all their homework at the time of the midterm test will be allowed to write it. The problems in the midterm tests will be selected from the homework assignments.

B, for a grade:

For their exam everybody will get an exam grade. The final grade will be the average of the seminar and exam grade. If it is for example (3.5) then the lecturer decides if it is (3) or (4).

Subject group "Professional Subjects" (for both specialisations)

Electronics II

Code: MK5ELT2R06RX17-EN

ECTS Credit Points: 6

Evaluation: exam

Year, Semester: 1st spring semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+4

Topics:

Power amplifiers with transistors, optoelectronics, Switching Power Supply, A/D and D/A converters, special operation amplifier circuits, data acquisition systems, pc supported data acquisition systems and introduction to SPICE programming.

Literature:

Compulsory:

- Electronic Circuits: Handbook for Design and Application, U. Tietze, Ch. Schenk, 2nd edition, 2008, ISBN-10: 3540004297

Schedule

1st week Registration week	
2nd week: **Lecture:** Overview of transistor topic. **Practice:** General description, laboratory regulations, Safety regulations and safety instruction. Introduction to Multisim environment.	3rd week: **Lecture:** Bipolar differential amplifier circuit **Practice:** simulation of transistor amplifier in Multisim environment
4th week: **Lecture:** Power amplifier **Practice:** simulation of bipolar differential amplifier in Multisim environment.	5th week: **Lecture:** Switching Power supply. Step up converter. **Practice:** simulation of a power amplifier in Multisim environment.
6th week: **Lecture:** Switching Power supply. Step down converters. **Practice:** Measurement of power amplifier in laboratory.	7th week: **Lecture:** Optoelectronics components and circuits. **Practice:** simulation of Switching Power supply in Multisim environment.
8th week: 1st drawing week	
9th week: **Lecture:** Special operation amplifier circuits (logarithmic and exponential). **Practice:** simulation of special operation amplifier circuit (logarithmic and exponential) in Multisim environment.	10th week: **Lecture:** Special operation amplifier circuits (oscillator and filter circuit) **Practice:** measurement of special operation amplifier circuit (logarithmic and exponential) in a laboratory.
11th week: **Lecture:** Analog-digital converters.	12th week: **Lecture:** Digital-Analog converter

Practice: simulation of special operation amplifier circuits (oscillator and filter circuit) in Multisim environment.	**Practice:** measurement of special operation amplifier circuits (oscillator and filter circuit) in a laboratory.
13th week:	**14th week:**
Lecture: introduction to data acquisition system.	**Lecture:** pc supported data acquisition system
Practice: introduction to NI MYDAQ system.	**Practice:** preparing control and measurement system with NI MYDAQ.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. Missed practice classes must be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as absence because of the lack of active participation in class. During the semester there are one test. Students have to sit for these tests.

Preparing measurement/simulation reports until deadline.

B, for grade:

At the end of the course an exam must be taken. The minimum requirement for end-term test is 41%. Score Grade 0-40 fail (1) 41-55 pass (2) 56-70 satisfactory (3) 71-85 good (4) 86-100 excellent (5).

Digital and Servo Drives

Code: MK5DIGSR06RX17-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Year, Semester: 1st fall semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+4

Topics:

Fundamentals of drive systems, operation modes. Kinematics equations for different applications. Summary of electrical machines: DC, AC (induction motors, synchronous motor), stepper motor, special motors: EC and BLDC. Electronic drive of electric motors: power electronics, and PWM method. Summary of mechanical components: drives, drive types, bearings, linear movements and guides. Sensor summary: measurement of linear and angular displacement with optical or induction sensors. Digital measurements and control circuits: microcontrollers and FPGAs.

Drive control: acceleration, speed and position control loops. Modelling of mechanical components, electrical machines and sensors in time and frequency domain. Description of open and closed loop control with transfer function and state space method. Performance analysis of control loops: step response and disturbance rejection.

Digital drive control: digital filtering, coordinate transform. Implementation of digital PID control law and parameter tuning. Implementation of digital state observer.

Literature:

Compulsory:

- Asif Sabanovics, and Kouhei Ohnishi, "Motion Control Systems", 2011 John Wiley & Sons, ISBN: 978-0-470-82573-0
- Robert Bishop, "Modern Control Systems with LabView", 2012, NTS Press, ISBN: 978-1-934891-18-6
- Robert Bishop, "Mechatronics Handbook", CRC Press, ISBN: 0-8493-0066-5

Schedule

1st week Registration week	
2nd week: **Lecture:** Servo Drives theory and applications. **Practice:** Position, speed, and acceleration curves for different applications.	3rd week: **Lecture:** Mechanical parts for servo drives summary: gearboxes, and gears, drives, linear drives, bearings. **Practice:** Mechanical parts practice.
4th week: **Lecture:** Sensor summary for servo drives: displacement, angular displacement measurement with optical, induction sensors. **Practice:** Sensor application examples. Sensor calibration practice.	5th week: **Lecture:** Electrical machines summary for servo drives: DC, AC (synchronous and induction) motors, stepping motor, special motors: EC, BLDC. **Practice:** Electrical machines applications.
6th week: **Lecture:** Power electronics for electrical machines: controlled rectifiers and PWM method. **Practice:** Electrical drive of electrical machines practice.	7th week: **Lecture:** Digital measurement and control: microcontrollers and FPGA-s. **Practice:** Digital control practice: microcontrollers and FPGA-s.

8th week: 1st drawing week	
9th week: **Lecture:** Drive control: acceleration, speed, and position control loops. **Practice:** Control loop practice.	10th week: **Lecture:** Modelling of mechanical parts, electrical machines and sensors in frequency and time domain. **Practice:** Servo drive modelling practice.
11th week: **Lecture:** Modelling of open and closed loop controls with transfer functions and state space method. **Practice:** Motion control loop practice.	12th week: **Lecture:** Control loop performance analysis: step response, disturbance rejection property. **Practice:** Control loop performance analysis practice.
13th week: **Lecture:** Servo drive control digital implementation: digital filtering of measurement signals, coordinate transformations. **Practice:** Implementation and tuning of discrete PID control loop.	14th week: **Lecture:** Disturbance observers in motion control applications. **Practice:** Digital implementation of state observer.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice** is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments to the course with them to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are two tests: the 1st test in the 7th week and the 2nd test in the 15th week. Students have to sit for the tests.

B, for grade:

The course ends in a **mid-semester grade** based on the test results.

The minimum requirement for both mid-term and end-term tests is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following (score/grade): 0-39 = fail; 40-52 = pass (2); 53-63 = satisfactory (3); 64-71 = good (4); 72-80 = excellent (5).

If the score of the sum of the two tests is below 40, the student once can take a retake test of the whole semester material.

Embedded Systems

Code: MK5BEAGR04RX17-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 2nd spring semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+4

Topics:

Fundamentals of embedded systems. Real (deterministic) and non-real (non-deterministic) time operation, control and data acquisition. Architecture, data and control processes, state machine implementation. Hardware architecture: peripheral circuits, CPU, FPGA, and field networks. Software architecture: deterministic and non-deterministic processes: user interface, network communication, deterministic control. RTOS (Real-Time Operating System) and FPGA implementation. FPGA and CPU communication: DMA and FIFO. Sharing variables: current value, queue, real-time FIFO, real-time shared variable.

Embedded software architecture, real-time program design patterns. Periodic and event-driven loops. State machines: user event and inter process communication. Producer-consumer design pattern.

Diagnostic of embedded systems: real-time monitoring of resources. Monitoring and storage of monitoring and operating data. Dynamic and static allocation of memory (resource).

Embedded system robustness: operation and implementation of watchdog.

Literature:

Compulsory:

- Alan Burns, Andy Wellings “Real-Time System and Programming Languages”, Addison-Wesley, 3rd ed. 2001, ISBN 0 201 72988 1
- National Instruments, „NI LabVIEW for CompactRIO Developer’s Guide”, 2017 ed.

- National Instruments “LabVIEW TM Real-Time Module User Manual” 2003 April ed.

Schedule

1st week Registration week	
2nd week: Practice: Embedded systems introduction. Embedded system development environment practice.	3rd week: Practice: System architecture, data and control streams, stream control state machines. Embedded system state machine programming practice.
4th week: Practice: Hardware architecture. I/O circuits, CPU, FPGA, field communication interface. Embedded system and networking practice.	5th week: Practice: Software architecture: deterministic and non-deterministic processes: user interface, network communication. User interface programming practice.
6th week: Practice: Deterministic software control loop architecture: RTOS (Real-time Operating System) and FPGA implementation. Deterministic control loop programming practice.	7th week: Practice: CPU and FPGA Communication: DMA and FIFO. DMA and FIFO programming practices.
8th week: 1st drawing week	
9th week: Practice: Non-real-time variable sharing among embedded systems and processes: tabs, and queues.	10th week: Practice: Real-time variable sharing among embedded systems and processes: real-time FIFOs, real-time shared variables.
11th week: Practice: Embedded system architectures, real-time programming patterns.	12th week: Practice: Periodic and even-driven loops. State machines: user and machine controlled state machines.
13th week: Practice: Producer-Consumer programming patterns.	14th week: Practice: Embedded system diagnostics: ream time monitoring of resources.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice** is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments to the course with them to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are two tests: the 1st test in the 7th week and the 2nd test in the 15th week. Students have to sit for the tests.

B, for grade:

The course ends in a **mid-semester grade** based on the test results.

The minimum requirement for both mid-term and end-term tests is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following (score/grade): 0-39 = fail; 40-52 = pass (2); 53-63 = satisfactory (3); 64-71 = good (4); 72-80 = excellent (5).

If the score of the sum of the two tests is below 40, the student once can take a retake test of the whole semester material.

Control Theory

Code: MK5IRAR04RX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 1st spring semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Mathematical description of systems in a continuous time and frequency domain: differential equations, status field description, Laplace transformation, transfer function. Description of system in a discrete time and frequency domain: discretization process, differential equations, discrete status model, Z-transformation, discrete differential

equations. Mechanical, electrical, thermic and hydrodynamic foundation blocks modelling, transform non-linear equations to linear. Characters of feedback systems: verifying signs, suppression of trouble sign. Stability of linear systems in a time and frequency domain. Root and Locus (Root-Locus) method. Planning of feedback status systems. Digital regulation: discrete PID regulation, planning and tuning of parameters, in a discrete time and frequency domain. Stability in a discrete domain.

Literature:

Recommended:

- Dorf, R.C., Bishop, R.H., "Modern Control Systems", 12th edition, 2011, Pearson / Prentice Hall. ISBN-13:978-0-13-602458-3
- Robert H. Bishop, "Modern Control Systems with LabVIEW" 2012, NTS Press, ISBN-13: 978-1-934891-18-6
- Robert H. Bishop, ed. "The Mechatronics Handbook", 2nd ed, 2008, CRC Press

Schedule

1st week Registration week	
2nd week: Lecture: Mathematical descriptions of systems in continues time and frequency domain. Laplace transformation. Practice: Practice the description of linear and non-linear mechanical, electrical, hydraulics and thermic systems.	3rd week: Lecture: Description of systems in a discrete time and frequency domain. Z transformation. Practice: Practice the description of linear and non-linear mechanical, electrical, hydraulics and thermic systems.
4th week: Lecture: Modelling of mechanical, electronical building blocks, make non-linear equations to linear. Practice: Computer modeling of mechanical and electronical building blocks.	5th week: Lecture: Modelling of thermic and thermodynamic building blocks, make non-linear equations to linear. Practice: Computer modeling of thermic and thermodynamic building blocks.
6th week: Lecture: Characteristics of feedback system: examiner signs, suppression of trouble signs, in a continuous time and frequency domain. Practice: Examination of feedback systems with computer simulation.	7th week: Lecture: Continuous examination of the stability of feedback systems in a time and frequency domain. Practice: Stability examinations with computer simulations.
8th week: 1st drawing week	
9th week:	10th week:

Lecture: Description of state space and discrete time domain.	**Lecture:** Status feedback in continues and discrete time domain.
Practice: Examination of state space with computer simulation.	**Practice:** Examination of status feedback with computer simulation.
11th week:	**12th week:**
Lecture: Planning of feedback with status estimator in a time domain.	**Lecture:** Digital regulations I: discrete PID regulation theory.
Practice: Planning exercise of status feedback.	**Practice:** Discrete PID regulation implementation.
13th week:	**14th week:**
Lecture: Discrete PI, PD and PID regulation, determination of its parameters.	**Lecture:** Discrete PI, PD and PID theory of stability of the regulation circle.
Practice: Exercises with discrete PI, PD and PID regulations.	**Practice:** Discrete PI, PD and PID regulation exercises.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Participation at practice, according to Rules and Regulations of University of Debrecen. The correct solution of the project and submission before deadline.

B, for grade:

Oral exam on theoretical part.

Image Processing

Code: MK5KEPFR04RX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 2nd spring semester

Its prerequisite(s): Control Theory

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Digital image formats. Cameras, lenses, fundamentals of photography, digital image acquiring. Camera calibration and geometrical measurements. Camera and real coordinate systems, transformations. Image filters: Gaussian, gradient, and smoothing. Morphology: dilatation and erosion: theory and applications. Pattern matching: finding and identification. Object finding and identification. Edge detection: theory and

applications. Colours, digital encoding of colours. Colour pattern finding and matching. Visual inspection: geometrical a colour measurements. Processing of barcodes and data matrixes.

Schedule

1st week Registration week	
2nd week: Lecture: Image processing introduction and application examples. Practice: Digital image processing programs and programming environments practice.	3rd week: Lecture: Cameras, optics, transformations, image acquisition. Practice: Camera calibration, image acquisition practice.
4th week: Lecture: Image display, lighting, colours. Practice: Calibration pattern design, lighting practice.	5th week: Lecture: Fundamental image processing: ROI, basic operators. Practice: Basic operators practice.
6th week: Lecture: Filters: theory, Gauss, Laplace, smoothing. Practice: Basic filters practice.	7th week: Lecture: Morphology: dilatation and erosion, particle filtering. Practice: Digital image processing with morphology practice.
8th week: 1st drawing week	
9th week: Lecture: Pattern matching theory, search and identification. Practice: Pattern matching practice.	10th week: Lecture: Object matching and measurement. Practice: Object matching practice.
11th week: Lecture: Colour pattern matching. Practice: Colour pattern matching practice.	12th week: Lecture: Coordinate transform between camera and real world. Practice: Coordinate transform practice and visual servo.
13th week: Lecture: Optical inspection of parts. Practice: Optical inspection practice.	14th week: Lecture: Optical identifiers: QR code, barcode, and numerical displays. Practice: Optical identifiers practice.
15th week: 2nd drawing week	

A, for a signature:

Participation at practice classes is compulsory. Students must attend practice classes and may not miss more than three occasions during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't take part in any practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed practice classes must be made up for at a later date, being discussed with the tutor.

During the semester there are two tests: the mid-term test on the 7th week and the end-term test on the 15th week. Students must sit for the tests.

B, for a grade:

The course ends in an examination.

The minimum requirement of the mid-term, the end-term test and the teamwork is 50% separately. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following (score/grade): 0-49 = fail; 50-62 = pass (2); 63-75 = satisfactory (3); 76-89 = good (4); 90-100 = excellent (5).

If the score of any test is below 50%, the student once can take a retake test of the whole semester material.

An offered grade: It may be offered for the students if the average of the mid-term test, end-term tests and the teamwork is at least good (4). The offered grade is the average of them.

Building Management Systems

Code: MK5EPINR04R117-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 1st fall semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+4

Topics:

Integrated management of geodata and descriptivedata. Knowledge of Primary and Secondary Data Acquisition Procedures. User-level knowledge of spatial software. The object under investigation in the building is the subject of detailed energy consumption data, building parameters, building materials, etc. This enables us to obtain data from various units of the facilities that contribute greatly to possible refinements for decision making

Literature:

Compulsory:

- Energy Plus-Engineering Reference, The Reference to Energy Plus Calculations (2013)
- Input Output Reference, The Encyclopedic Reference to Energy Plus Input and Output (2013)
- Havasi, I. – Bartha, G. 2011: Introduction to GIS I., Miskolci Egyetem Földtudományi Kar
- Havasi, I. – Bartha, G. 2011: Introduction to GIS II. – Satellite Global Positioning Systems, Miskolci Egyetem Földtudományi Kar
- Elek, I. – Elek, Zs. – Nguyen Thai Binh. 2012: Building Spatial Databases – Theory, Eötvös Lóránd University, Faculty of Informatics

Schedule

1st week Registration week

2nd week:	**3rd week:**

Practice: The role of GeographicalInformation System (GIS) inEngineering. Other fields of application of GIS. EOV/EOTR and WGS84 referencesystems.Map, traverse-map and building design reading, geoinformation, modelling. Applicated of GPS devicesinpractice. Location. Coordinate definitions. Assigning data and descriptive data to coordinates, data processing.

4th week:

Practice: Create yourown map, vectorize. Preparation of hybrid stock and retention of abstraction. Digitalization.- Working with objects, scanning, digitizing files, raster images into the drawing file and processing them. Use AutoCAD layers in an object-oriented way, display a map or a private object, create and digitize your own map. Digitally capture the real world's abstraction in the AutoCAD format according to a GIS program.

6th week:

Practice: Creation of a Geospatial Module (AutoCAD drawing conversion and database file embedding and structured database work). Assign a thematic database to the recorded geographic data. Prepare structured database queries. Thematic querying and recording of student tasks. Selecting and assigning data files to specific areas of geoinformation. Applying the knowledge to date in the student task. Preparation, creation and recording of thematic maps. SQL. Queries, searches, and evaluations with the structured data base. Presentation, evaluation and correction of thematic files. Independent student work, consultation. Describing, editing, and consolidating application areas for tasks.

Practice: Notion of data (Data collection, data management, data analysis, data presentation). Data Acquisition Procedures. Creating databases. Components of the system (hardware, software, data, users).- AutoCAD basic concepts in geospatial formulation. Geodatasources, scanninganalog maps, digitizing files, recording metric ratios in AutoCAD.

5th week:

Practice: Handle descriptive data, create a table, align it to the map file, fix it according to a GIS application. Drawings, layers, digitization rules.Description of the Geospatial UserPackage (MapInfo Pro 16.0).Incorporating database and drawing into GIS software. Working with a structured database (SQL). Creating thematic information.Discussing and publishing individual tasks. Compare field data with Google Earth database.Creating a My Own File with AutoCAD. Field data processing.Digitize your own stock, taking into account sequences. Create a database (Excel). Add a map to AutoCAD. Merging geoinformation and descriptive data into GIS software. Layer design, digitization.

7th week:

Practice: Theoretical foundations of building models for energy consumption in buildings. Introduction of the EnergyPlus program. Zoning, simplification of the model

Consultation. Task submission evaluation, repair.	
8th week: 1st drawing week	
9th week: **Practice:** Making a geometric model of a real building. Methods for specifying building parameters.	**10th week:** **Practice:** Implementing the building elements of a real building in the EnergyPlus program
11th week: **Practice:** Perform simulations, evaluate results	**12th week:** **Practice:** Development and simulation of renovation proposals that optimize energy consumption for real buildings using GenOpt
13th week: **Practice:** Student Individual Problem Solving. Consultation. Preparing the results for embedding into the building informatics software.	**14th week:** **Practice:** Rebuilding building information data into the GIS. Retrieving new information and analyzes, queries.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. Missed practice classes must be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. The student has to prepare individual project and present it.

B, for grade:

For the mid-semester grade the student has to prepare individual project and present it. The grade is based on the quality of the submitted project and the presentation.

Building Physics

Code: MK5EPFIR06R117-EN

ECTS Credit Points: 6

Evaluation: exam

Year, Semester: 1st fall semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Topics: Internal and solar gains of a building. Radiation. Specific heat. Thermal diffusivity. Temperature variation in a multi-layer building element. Heat transfer by radiation. Air gaps. Thermal bridges. Humid air. Surface and capillary condensation. Sorption. Interstitial condensation. Air and vapour barrier. Thermal storage. Decrement factor and time lag. Air tightness of buildings. Sunspace and Trombe wall. Prediction of thermal comfort in buildings.

Literature:

Compulsory:

- Hugo L. Hens, Building Physics and Applied Building Physics – Package, Wiley, 2012, ISBN: 978-3-433-03031-8, 568 pages.
- Gudni A. Jóhannesson, Building Physics, Terc Kft., 2013, 978-963-9968-86-8, 104 pages.
- ASHRAE Handbook Fundamentals, 2007

Schedule

1st week Registration week	
2nd week: **Lecture:** Internal and solar gains of a building. Balance point temperature. Degree-day curve and calculation. **Practice:** Solving problems based on the theme of the lecture.	**3rd week:** **Lecture:** Solar radiation. Irradiance. Global radiation. Beam radiation. Diffuse radiation. Solar constant. Analysis of temperature field in case of one dimensional steady state heat conduction. Temperature field. Thermal conductivity. **Practice:** Solving problems based on the theme of the lecture.
4th week: **Lecture:** Specific heat. Thermal diffusivity. Unsteady state heat transfer. Steady state heat transfer. Heat transfer by convection. Temperature variation in a multi-layer building element. **Practice:** Solving problems based on the theme of the lecture.	**5th week:** **Lecture:** Heat transfer by radiation. Planck's law. Wien's law. Kirchoff's law. Stefan Boltzmann's law. Lambert's law. **Practice:** Solving problems based on the theme of the lecture.
6th week:	**7th week:**

Lecture: Air gaps. Built-in heat conductivity of insulating materials. **Practice:** Solving problems based on the theme of the lecture.	**Lecture:** Thermal bridges. **Practice:** Solving problems based on the theme of the lecture.
8th week: 1st drawing week	
9th week: **Lecture:** Humid air. Psichrometer. Enthalpy of humid air. Dew point temperature. **Practice:** Solving problems based on the theme of the lecture.	**10th week:** **Lecture:** Surface and capillary condensation. Sorption. Interstitial condensation. **Practice:** Solving problems based on the theme of the lecture.
11th week: **Lecture:** Air and vapour barrier. **Practice:** Solving problems based on the theme of the lecture.	**12th week:** **Lecture:** Thermal storage. Decrement factor and time lag. **Practice:** Solving problems based on the theme of the lecture.
13th week: **Lecture:** Air tightness of buildings. Sunspace and Trombe wall. **Practice:** Solving problems based on the theme of the lecture.	**14th week:** **Lecture:** Prediction of thermal comfort in buildings. PMV and PPD values. **Practice:** Test 2.
15th week: 2nd drawing week	

Requirements

A, for a signature:

To obtain the signature in the Neptun:

1. Attendance at the courses and seminars according to the regulation of UD
2. At least grade 2 at two Tests (only exercises) written on 8th and 14th week of the Semester.

B, for a grade:

Witten or oral exam (only theoretical questions) in the exam period.

The final grade (FG) is calculated as follows:

$$FG=0.25\times T1+0.25\times T2+0.5\times E$$

T1 – grade obtained at Test 1 (≥ 2)

T2 – grade obtained at Test 2 (≥ 2)

E – grade obtained at the written or oral exam (≥ 2)

The grade for the test and the exam is given according to the following (score/grade): 0-50 % = fail (1); 51-60 % = pass (2); 61-74 % = satisfactory (3); 75-89 % = good (4); 90-100 % = excellent (5).

Building Service Systems and Elements

Code: MK5EPRER04R117-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 2nd spring semester

Its prerequisite(s): Building Management Systems, Building Physics

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+4

Topics:

Elements of water supply systems. Design methods. Waste water system. Domestic hot water supply systems. Requirements, standards. Gas supply system elements. Chimney systems and design methods. Heat distribution devices in heating systems. Classification of boilers, constructions, choosing boilers. Investment costs, operating costs. Efficiency of non-condensing and condensing boilers. Annual fuel demand. Dimensioning the pump, pump efficiency, law of affinity, parallel connected pumps, pump performance control, elements in speed controlling.

Air handling units. Elements: filter, heat recovery, heat exchanger, fans. Sound silencers. Fire dampers. Air diffusers. Insulation of air ducts; requirements.

Solar systems, vacuum tube and flat solar panels.

Cooling systems. Components of chillers.

Literature:

Compulsory:

- Harvey, Leslie Daryl Danny (2006) A handbook on low-energy buildings and district-energy systems: fundamentals, techniques and examples, ISBN: 1844072436, 9781844072439, 701 pages.
- ASHRAE Handbook Fundamentals, American Society of Heating, Refrigerating and Air-Conditioning Engineers, 2005, 2009, 2013

Recommended:

- Nils R. Grimm, Handbook of HVAC Design, McGraw Hill Publishing Company, 1990
- Reddy, T. Agami (2017) Heating and cooling of buildings : principles and practice of energy efficient design. ISBN: 9781439899892, 859 p.

Schedule

1st week Registration week	
2nd week: **Practice:** Basic of water supply systems. System elements. Domestic hot water systems. Requirements, standards.	3rd week: **Practice:** Waste water systems. Rainwater systems. System elements. Requirements, standards.
4th week: **Practice:** Gas supply systems. Chimney systems and design methods.	5th week: **Practice:** Heating systems. Gasboilers. Classification of boilers, constructions, choosing boilers.
6th week: **Practice:** Efficiency of non-condensing and condensing boilers. Annual fuel demand. Investment costs, operating costs.	7th week: **Practice:** Dimensioning the pump, pump efficiency, law of affinity, parallel connected pumps, pump performance control, elements in speed controlling.
8th week: 1st drawing week	
9th week: **Practice:** Air handling unit element: filter, heat recovery heat exchangers, fans.	10th week: **Practice:** Dimension of air ducts. Sound silencers. Fire dampers. Air diffusers. Air duct insulaton. Requirements.
11th week: **Practice:** Solar system elements. Vacuum tube and flat panels.	12th week: **Practice:** Cooling system elements.
13th week: **Practice:** Operation of chillers. Chilled water distribution systems.	14th week: **Practice:** End-term test.
15th week: 2nd drawing week	

Requirements

A, for signature:

Participation at **practice** is compulsory. Student must attend the practices and may not miss more than three practice during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Being late is

counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor.

During the semester there is a test in the 15th week. Students have to sit for the test.

B, for grade:

The course ends in mid-term test.

The grade is calculated from result of the test.

The minimum requirement for the test is 50%. The grade for the test is given according to the following table:

0-50: fail (1); 51-60: pass (2); 61-70: satisfactory (3); 71-80: good (4); 81-100: excellent (5)

If the score of the test is below 50%, the student once can take a retake test covering the whole semester material.

Building Automation

Code: MK5EAUTR06R117-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Year, Semester: 2nd fall semester

Its prerequisite(s): Building Management Systems, Building Physics

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+4

Topics:

Review of main components of building automation: sensors, actuators, actuator drives. Architecture of building automation: sensor-actuator level, zone controllers, field network, gateway and data transform layer, WAN layer and supervisor software layer. Zone controllers: free parameter controller, free program controllers, zone temperature control, central controller, outdoor temperature follower control. Building Management System (BMS) network, and network components, field networks: (1) Wired: ModBus, LON(Talk), BACnet, (2) Wireless: ZigBee.

HVAC control: basic of thermodynamics, thermal cycles for cooling, water chillers, cooling performance control. Air duct systems basics: evaporate chiller, indoor air heating, heat recovery application, HVAC control laws. Application of renewable energy utilization engines and control technology: PV panel, thermal panel, and heat pumps.

Electronic fire alarm system. Identification systems: knowledge, optical, electronic and biometric identification systems. Electricity distribution of buildings. UPS (Uninterruptible power supply), redundancy principle. Security and protection of facilities.

Literature:

Compulsory:

- NJATC: Building automation – Control devices and applications, ISBN-10: 9780826920003
- NJATC: Building automation – System integration with open protocols, ISBN-10: 0826920128
- CIBSE: Building control systems, 2009, 9781906846008
- Robert H. Bishop: Mechatronics Handbook: Sensors and actuators (Section Three)

Recommended:

- Sabrie Soloman, Sensors Handbook, Mac-Grow Hill Company, 2010, ISBN: 978-0-07-160571-7, Available on-line at: http://ailab.ijs.si/~blazf/kro/SL/Soloman%20-%20Sensors%20Handbook%202nd%20Edition%20-%202010.pdf

Schedule

1st week Registration week	
2nd week: **Lecture**: Base definition of building automation: open-loop control and closed-loop control, continuous control and state control. Main parts of building control elements **Practice:** Calculation examples in Building automation topics	3rd week: **Lecture:** Sensors in building automation: temperature, humidity, motion, CO2, pressure, light sensor, etc. **Practice:** Calculation examples in Building automation topics
4th week: **Lecture:** Actuators, actuator drives in building automation. **Practice:** Calculation examples in Building automation topics	5th week: **Lecture:** Zone controllers: free parameter controller, free program controllers, zone temperature control, central controller, outdoor temperature follower control **Practice:** Calculation examples in Building automation topics
6th week: **Lecture:** Control strategies in heating systems. **Practice:** Classified practice	7th week: **Lecture:** Control strategies in cooling and ventilation systems. **Practice:** Overview of working principles and operational examples of renewable energy systems
8th week: 1st drawing week	
9th week: **Lecture:** Field networks: (1) Wired: ModBus, LON(Talk), BACnet, (2) Wireless: ZigBee.	10th week: **Lecture:** Architecture of building automation: sensor-actuator level, zone controllers, field network, gateway and data transform layer, WAN layer and supervisor software layer.

Practice: Practical demonstration of the main components of building engineering and control equipment	**Practice:** Practical demonstration of BMS (Building Management System)
11th week: **Lecture:** Electronic fire alarm system. **Practice:** Practical demonstration of fire alarm system	**12th week:** **Lecture:** Identification systems: knowledge, optical, electronic and biometric identification systems. **Practice:** Practical demonstration of access control system.
13th week: **Lecture:** Electricity distribution of buildings. UPS (Uninterruptible power supply), redundancy principle. **Practice:** Practical application of Building Electricity Simulation Board	**14th week:** **Lecture:** Security and protection of facilities. **Practice:** Risk Analysis Example, Implementation Example, Examples of Real Risk Events in facility's security technology
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. Missed practice classes must be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. Students has to prepare individual projects and present them.

B, for a grade:

For the mid-semester grade a student has to write two tests. The mid-semester grade is received according to a scoring system (total 100) seen below:

- 1st test with 40 points
- 2nd test with 40 points
- individual project with 20 points

The mid-semester grade is given according to the following table:

Score	0-59	60-69	70-79	80-89	90-100
Grade	fail (1)	pass (2)	satisfactory (3)	good (4)	excellent (5)

Project of Building Mechatronics and Smart Spaces I

Individual Project Work

Project of Building Mechatronics and Smart Spaces II

Individual Project Work

Cyber Security

Code: MK5KIBER4R217-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 1st fall semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+4

Topics:

To get to know cyber security, and within it the critical information regarding the safety of the infrastructure, also the blocks of safety and the criteria of formative, condition and function systems. To give an insight into the infrastructure of the components of security, and the requirements of its planning. To help in getting to know the new research results regarding the field. To motivate the students to engage in research in new fields. The module helps the students in acquiring knowledge regarding their field of research by learning the basics in engineering - security science.

Schedule

1st week Registration week	
2nd week: **Practice:** Introduction to the web of security problems. The cyber dangers and the complex handling of it. Global cyber security and in regards to home.	**3rd week:** **Practice:** The set-up of the internet and the outline of how it works. (ISP, IXP, POP, network backbone). Layered architecture ISO/OSI, TCP/IP and hybrid models.
4th week: **Practice:** Wireless technologies, VPN base and monitoring network systems.	**5th week:** **Practice:** Network operating systems security, firewall operation. Monitoring of network systems.
6th week: **Practice:** Foundation knowledge in cryptography, Encrypted algorithms.	**7th week:** **Practice:** Classified workshop.
8th week: 1st drawing week	
9th week: **Practice:** Digital identifier, safety of communication services.	**10th week:** **Practice:** Authentication protocols. E-mail and web safety.

11th week: **Practice:** Analyzing digital footprints in the IT event space Sealog.	12th week: **Practice:** Minimizing losses through imposition-scan Sealog
13th week: **Practice:** Features of cyber-crime, classification of IT crimes. Weak points of given webs.	14th week: **Practice:** Classified workshop.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Partaking in workshops in compliance with the regulations of the Rules and Regulations. The correct keys to homework and respecting the deadlines. Solving assorted tasks.

B, for grade:

The practical grade is the evaluation of project.

Workshop grade on assignments and average on final exams.

XX in the Loop Systems

Code: MK5XXLRR6R217-EN

ECTS Credit Points: 6

Evaluation: exam

Year, Semester: 1st fall semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

The put together, in real time, during the testing of the embedded critical systems the so called hardware in the loop (HIL) testing technique was used. The HIL makes troubleshooting more efficient, and makes the product's waiting time to get on the market shorter, and lessens the improvement costs. The goal of these proceedings, that the examined tool used during testing, to be in a similar physical environment and to function. The making of the HIL system is complex and is about integration the systems and simulations into the environment. Real time simulations to be done in a simulation environment, and measurement of virtual telemetry data and make meaning of them. To apply changes on the given simulation system, to make it more efficient.

Literature:

Recommended:

- Encyclopedia of Automotive Engineering, Discrete Engineering to Configure the ECU and Components (2014), Susanne Köhl, Markus Plöger, DOI: 10.1002/9781118354179.auto193
- Hardware-in-the-Loop Simulation, (2015) Ron T. Ogan, ISBN 978-1-4471-5633-8

Schedule

1st week Registration week	
2nd week: **Lecture:** cRIO and configuration. **Practice:** Make a hardware and software demonstrative HIL environment (National instruments or on other tools).	3rd week: **Lecture:** Use of simulation toolkit on cRIO system. **Practice:** Make a hardware and software demonstrative HIL environment (National instruments or on other tools).
4th week: **Lecture:** Inter-process communication. **Practice:** Make a hardware and software demonstrative HIL environment (National instruments or on other tools).	5th week: **Lecture:** Communication with computer. **Practice:** Make a hardware and software demonstrative HIL environment (National instruments or on other tools).
6th week: **Lecture:** Programming of FPGA. **Practice:** Make a hardware and software demonstrative HIL environment (National instruments or on other tools).	7th week: **Lecture:** Theoretical test writing. **Practice:** Make a hardware and software demonstrative HIL environment (National instruments or on other tools).
8th week: 1st drawing week	
9th week: **Lecture:** Communication with the FPGA core. **Practice:** Make a hardware and software demonstrative HIL environment (National instruments or on other tools).	10th week: **Lecture:** Use of PWM. **Practice:** Make a hardware and software demonstrative HIL environment (National instruments or on other tools).
11th week: **Lecture:** Servo and step motor usage. **Practice:** Make a hardware and software demonstrative HIL environment (National instruments or on other tools).	12th week: **Lecture:** Temperature control. **Practice:** Hand in assignment.
13th week: **Lecture:** Implementation of HIL. **Practice:** HIL rating.	14th week: **Lecture:** Theoretical test writing. **Practice:** HIL rating.

15th week: 2nd drawing week

Requirements

A, for a signature:

Participation on practice, according to Rules and Regulations. The correct solution of the homework and submission before deadline.

B, for grade:

Oral exam on theoretical part.

Modelling Robots

Code: MK5ROMOR04R217-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 2nd spring semester

Its prerequisite(s): Cyber Security, XX in the Loop Systems

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+4

Topics:

During the module the robot cells conception happens with the planning of 3D models. The goal of 3D models in this case, to see the making of robot cells transparently, and the core of its functioning to be seen. The first part of the module, the foundations of modelling will be introduced with the help of Maple and RoboDK.

Its functioning can be best seen by simulation, in which some elements (robots, carry tools, material) move. These simulation programs are made available by most robot manufacturing companies to be used by those who interrogate their functioning. For example: KUKA the KUKA Sim Pro, ABB the Robotstudio software, etc.

The second part of the module teaches the modelling made on the basis of these softwares.

Schedule

1st week Registration week	
2nd week: Practice: System models. The purpose of system dynamic. Modeling of the same plane hinged robots.	3rd week: Practice: The mathematical description of dynamical systems.
4th week:	5th week:

Practice: The programing of robot foundations. Coding of robot movements and its description. General principles of path generating, LIN, CIRC, linear interpolation, Circular interpolation.	**Practice:** Same plane arm with wrist robot modeling on the robot's scheme.
6th week: **Practice:** Modeling in RoboDK.	7th week: **Practice:** Hand in project.
8th week: 1st drawing week	
9th week: **Practice:** Modeling and foundation calculations in MATLA and Robotics tool box.	10th week: **Practice:** Modeling and foundation calculations in MATLA and Robotics tool box.
11th week: **Practice:** Robot system modeling in Scilab environment.	12th week: **Practice:** Robot system modeling in Scilab environment.
13th week: **Practice:** Modeling of manufacturing cells.	14th week: **Practice:** Hand in project.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Participation on practice, according to the Rules and Regulations. The correct solution of the homework and submission before deadline. Solving assorted tasks.

B, for grade:

Average value of project.

Components of Cyber-Physical Systems

Code: MK5KIROR06R217-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Year, Semester: 2nd fall semester

Its prerequisite(s): Cyber Security, XX in the Loop Systems

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+4

Topics:

Cloud platforms and autonomous technology computing modelling, planning of CPS systems using AR+VR technology. Writing optimal computer programs based on augmented reality programs. Virtual Reality, write and use programs fit to interact. Make safe web systems for CPS usage. Connecting robots on the web, and counting through the web equipment. Foundations of data mining and data analysing for logistic purposes.

Literature:

Recommended:

- Industry 4.0, Gilchrist, Alasdair (2016), ISBN 978-1-4842-2046-7
- The Second Machine Age: Work, Progress and Prosperity in a Time of Brilliant Technologies, Erik Brynjolfsson & Andrew McAfee, (2014), ISBN-10: 0393239357
- The Silent Intelligence, Daniel Kellmereit & Daniel Obodovski (2014), ISBN-10: 0989973700

Schedule

1st week Registration week	
2nd week: **Lecture:** Virtualization: overview, platform level virtualization. **Practice:** Creation of cyber physical system on chosen platform.	3rd week: **Lecture:** Cloud platforms and technologies I.:IaaS, PaaS, Carrier grade clouds micro cloud and cell technologies risk factors. **Practice:** Creation of cyber physical system on chosen platform.
4th week: **Lecture:** Autonomous computing: service usage safety and quality foundation concepts, levels, MAPE-K: proceeding level system management, system reconnaissance and modeling (CMDB), monitoring. **Practice:** Creation of cyber physical system on chosen platform	5th week: **Lecture:** Modelling: dynamic systems, real time requirement, CBS standards and cloud simulation, empirical methods, application in sandbox environment. **Practice:** Creation of cyber physical system on chosen platform.
6th week: **Lecture:** Cyber physical systems and applications. Embedded and intelligent engineering network upgrade. Intelligent manufacturing application, measurement of physical activity. Intelligent transport, logistic and vehicle applications. Intelligent agricultural and food industry applications.	7th week: **Lecture:** Theoretical test writing. **Practice:** Give in homework, ratings.

Energy efficiency research, energy saving solutions, green ICT systems. **Practice:** Creation of cyber physical system on chosen platform.	
8th week: 1st drawing week	
9th week: **Lecture:** CPS system planning, AR+R technology usage. **Practice:** Create AR and VR systems.	**10th week:** **Lecture:** Optimization and writing of augmented reality based programs. Virtual reality, writing and application of interactive program. **Practice:** Create AR and VR systems.
11th week: **Lecture:** Creation of secured web system for CPS goals. **Practice:** Create AR and VR systems.	**12th week:** **Lecture:** Connect robots to the web, make measurements through the web tools. **Practice:** Create AR and VR systems.
13th week: **Lecture:** Foundation of Data Mining and analyse data for logistic purposes. **Practice:** Create AR and VR systems.	**14th week:** **Lecture:** Theoretical test writing. **Practice:** Give in homework, ratings.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Participation at practice, according to Rules and Regulations. The correct solution of the project and submission before deadline. Effective solution of theoretical tests.

B, for a grade:

The average value of tasks and tests.

Project of Cyber Physics I

Code: MK5KIB1R04R217-EN

ECTS Credit Points: 4

Evaluation: mid-semester grade

Year, Semester: 2nd spring/fall semester

Its prerequisite(s): Cyber security, XX In the Loop systems

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+14

Topics:

Project of Cyber Physics I. module is the solution of a project assignment on an individual basis. During this time the student has to choose a project together with their consultant, the project has to be planned and executed. The project will be presented and rated in the first week of exam session, and will have their results on the career day, each graded individually.

For the rating, each individual has to make a summary of their project. On different pages, in one copy the project to be handed in, has to be minimum of 5 and maximum of 6 pages if written in Hungarian language, about the results attained while working on the project.

Compilation of literature record: according to the ISO 690:2010 guidelines, mechatronics engineers generally use the IEEE referencing, which is in accordance with the ISO 690:2010 guidelines.

Literature: -

Schedule

1st week Registration week	
2nd week: Practice: Solution of an individual project by supervisor.	3rd week: Practice: Solution of an individual project by supervisor.
4th week: Practice: Solution of an individual project by supervisor.	5th week: Practice: Solution of an individual project by supervisor.
6th week: Practice: Solution of an individual project by supervisor.	7th week: Practice: Solution of an individual project by supervisor.
8th week: 1st drawing week	
9th week: Practice: Solution of an individual project by supervisor.	10th week: Practice: Solution of an individual project by supervisor.
11th week: Practice: Solution of an individual project by supervisor.	12th week: Practice: Solution of an individual project by supervisor.
13th week: Practice: Solution of an individual project by supervisor.	14th week: Practice: Solution of an individual project by supervisor.

15th week: 2nd drawing week

Requirements

A, for a signature:

Participation on practice, according to the Rules and Regulations. The correct solution of the project and submission before deadline.

B, for grade:

The practical grade is the evaluation of project.

Project of Cyber Physics II

Code: MK5KIB2R6R217-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Year, Semester: 2nd spring/fall semester

Its prerequisite(s): Cyber security, XX In the Loop systems

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 0+16

Topics:

Project of Cyber Physics II. module is the solution of a project assignment on an individual basis. During this time the student has to choose a project together with their consultant, the project has to be planned and executed. The project will be presented and rated in the first week of exam session, and will have their results on the career day, each graded individually.

For the rating, each individual has to make a summary of their project. On different pages, in one copy the project to be handed in, has to be minimum of 5 and maximum of 6 pages if written in Hungarian language, about the results attained while working on the project.

Compilation of literature record: according to the ISO 690:2010 guidelines, mechatronics engineers generally use the IEEE referencing, which is in accordance with the ISO 690:2010 guidelines.

Literature:

Compulsory: -

Schedule

1st week Registration week	
2nd week:	3rd week:
Practice: Solution of an individual project by supervisor.	Practice: Solution of an individual project by supervisor.

4th week: **Practice:** Solution of an individual project by supervisor.	5th week: **Practice:** Solution of an individual project by supervisor.
6th week: **Practice:** Solution of an individual project by supervisor.	7th week: **Practice:** Solution of an individual project by supervisor.
8th week: 1st drawing week	
9th week: **Practice:** Solution of an individual project by supervisor.	10th week: **Practice:** Solution of an individual project by supervisor.
11th week: **Practice:** Solution of an individual project by supervisor.	12th week: **Practice:** Solution of an individual project by supervisor.
13th week: **Practice:** Solution of an individual project by supervisor.	14th week: **Practice:** Solution of an individual project by supervisor.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Participation on practice, according to Rules and Regulations. The correct solution of the project and submission before deadline.

B, for grade:

The practical grade is the evaluation of project.

DIPLOMA

Within 30 days of the successful final exam the diploma is issued and given out by the Faculty at the graduate's special request. Otherwise, the diploma will be awarded to him/her at the graduation ceremony of the Faculty.

The diploma is an official document decorated with the coat of arms of Hungary which verifies the successful completion of studies in the Mechatronical Engineering graduate program. The diploma contains the following data: name of HEI (higher education institution); institutional identification number; serial number of diploma; name of diploma holder; date and place of his/her birth; level of qualification; training program; specialisation; mode of attendance; place, day, month and year issued. Furthermore, it has to contain the rector's (or vice-rector's) original signature and the seal of HEI. It has to contain the rector's (in case of being prevented from attending the vice-rector for educational affairs) original signature and the imprint of the official stamp of the tertiary institute. The university has set up a central register of diplomas issued.

At the graduate's special request, a certificate on the completion of studies is issued. The document does not contain any reference to qualification, it merely proves that the candidate has taken a successful final exam. The Faculty keeps a record of the certificates issued.

Calculation of a diploma grade according to this formula

Grade: 0.5×A+0.5×B, where

A: Average of the grades of the subjects of the final exam

B: Grade for the thesis

On the basis of the calculated average grade the classification of the award:

Outstanding	4,81 – 5,00
Excellent	4,51 – 4,80
Good	3,51 – 4,50
Satisfactory	2,51 – 3,50
Pass	2,00 – 2,50

Diploma with Honours

An award with Distinction is permitted where a student obtained grade 5 in all subjects of the final exam. The average of thesis grade, his/her exam grades and mid-semester grades during his/her studies is at least 4.

MODEL CURRICULUM OF MECHATRONICAL ENGINEERING MSC - BUILDING MECHATRONICS AND INTELLIGENT BUILDINGS SPECIALISATION

The curriculum of the program is available in excel format on the webpage of the Faculty of Engineering (https://eng.unideb.hu/en/node/195).

Nr.	Subject group	Subject name	code	1st spring semester				1st fall semester				2nd spring semester				2nd fall semester				Prerequisites
				l	p	e	cr	l	p	e	cr	l	p	e	cr	l	p	e	cr	
1.	Natural Sciences	Mathematics IV	MK5MAT4A04RX17-EN	2	2	m	4													
2.		Mathematics V	MK5MAT5A04RX17-EN					2	2	m	4									
3.		Spatial Mechanisms and Dynamical Systems	MK5DINRG06RX17-EN	4	2	e	6													
4.		Materials Science	MK5ANTUG06RX17-EN					2	2	m	6									
5.	Economics and Humanities	Economical, Financial and Investment Decisions for Engineers	MK5BERUM06XX17-EN	2	4	m	6													
6.		Engineering Leadership and Organizational Methods	MK5VEZMM04XX17-EN					2	2	e	4									
7.	Specific Compulsory Subjects	Electronics II	MK5ELT2R06RX17-EN	2	4	e	6													
8.		Digital and Servo Drives	MK5DIGSR06RX17-EN					0	4	m	6									
9.		Embedded Systems	MK5BEAGR04RX17-EN									0	4	m	4					
10.		Control Theory	MK5IRAER04RX17-EN	2	2	e	4													
11.		Image Processing	MK5KEPFR04RX17-EN									2	2	e	4					MK5IRAER04RX17-EN
12.	Differentiated Professional Subjects	Building Management Systems	MK5EPINR04R117-EN					0	4	m	4									
13.		Building Physics	MK5EPFIR06R117-EN					2	2	e	6									
14.		Building Service Systems and Elements	MK5EPRER04R117-EN									0	4	m	4					MK5EPINR04R117-EN;MK5EPFIR06R117-EN
15.		Building Automation	MK5EAUTR06R117-EN													2	4	m	6	MK5EPINR04R117-EN;MK5EPFIR06R117-EN
16.		Project of Building Mechatronics and Smart Spaces I*	MK5EIT1R04R117-EN									0	14	m	4					MK5EPINR04R117-EN;MK5EPFIR06R117-EN
17.		Project of Building Mechatronics and Smart Spaces II*	MK5EIT2R06R117-EN													0	16	m	6	MK5EPINR04R117-EN;MK5EPFIR06R117-EN
18.		MSc Diploma Thesis I*	MK5DIP1R15RX17-EN									0	6	m	15					
19.		MSc Diploma Thesis II*	MK5DIP2R15RX17-EN													0	6	m	15	
		Internship	MK5SZGYR00RX17-EN									4 weeks		s	0					
	Criterium Subjects	Optional Subjects**					3												3	* The marked subjects are available in both semesters. In the third semester you are supposed to register for Project of Cyber Physics I and MSc Diploma Thesis I, in the fourth semester for Project of Cyber Physics II and MSc Diploma Thesis II.
		Physical Education		1 semester during the studies																
		Work and Fire Safety Course		Online course (can be taken in any semester)																
			Total:	12	14			8	16			2	30			2	26			
	State exam consists of three parts:		*Classes per week total:*	26				24				32				28				
	1. Elaborating tasks in writing (duration: 3 hours): Topic: Theories and Methods of Mechatronics. Questions are based on the material of the following courses: Spatial Mechanisms and Dynamical Systems; Electronics II; Embedded Systems along with all the courses of the selected specialization		*Credits:*				29				30				31				30	** Optional subjects according to Rules and Regulations of the Faculty: at least 6 credits (can be taken in any semester).
			Credits total:	**120**																
	2. Answers to questions related to the field of the diploma project. Candidates will have time for preparing drafts for the questions. Topics (3-5) will be provided after diploma submission.		*Exam:*			3				2				1				0		
			Mid-Semester Grade:			2				4				4				3		
	3. Diploma defence: submitted in writing. Presentation on diploma project; answers to questions, remarks in connection with the topic of the diploma.																			
			Abbreviations: L= Lecture, P= Practice, E= Evaluation, C= Credits, e = exam, m = mid-semester grade, s= signature																	

MODEL CURRICULUM OF MECHATRONICAL ENGINEERING MSC - CYBER-PHYSICAL SYSTEMS SPECIALISATION

The curriculum of the program is available in excel format on the webpage of the Faculty of Engineering (https://eng.unideb.hu/en/node/195).

Nr.	Subject group	Subject name	Code	1st spring semester				1st fall semester				2nd spring semester				2nd fall semester				Prerequisites
				L	P	E	C	L	P	E	C	L	P	E	C	L	P	E	C	
1.	Natural Sciences	Mathematics IV	MK5MAT4A04RX17-EN	2	2	m	4													
2.		Mathematics V	MK5MAT5A04RX17-EN					2	2	m	4									
3.		Spatial Mechanisms and Dynamical Systems	MK5DINRG06RX17-EN	4	2	e	6													
4.		Materials Science	MK5ANTUG06RX17-EN					2	2	m	6									
5.	Economics and Humanities	Economical, Financial and Investment Decisions for Engineers	MK5BERUM06XX17-EN	2	4	m	6													
6.		Engineering Leadership and Organizational Methods	MK5VEZMM04XX17-EN					2	2	e	4									
7.	Specific Compulsory Subjects	Electronics II	MK5ELT2R06RX17-EN	2	4	e	6													
8.		Digital and Servo Drives	MK5DIGSR06RX17-EN					0	4	m	6									
9.		Embedded Systems	MK5BEAGR04RX17-EN									0	4	m	4					
10.		Control Theory	MK5IRAER04RX17-EN	2	2	e	4													
11.		Image Processing	MK5KEPFR04RX17-EN									2	2	e	4					MK5IRAER04RX17-EN
12.	Differentiated Professional Subjects	Cyber Security	MK5KIBER04R217-EN					0	4	m	4									
13.		XX in the Loop Systems	MK5XXLRR06R217-EN					2	2	e	6									
14.		Modelling Robots	MK5ROMOR04R217-EN									0	4	m	4					MK5KIBER04R217-EN;MK5XXLRR06R217-EN
15.		Components of Cyber-Physical Systems	MK5KIROR06R217-EN													2	4	m	6	MK5KIBER04R217-EN;MK5XXLRR06R217-EN
16.		Project of Cyber Physics I*	MK5KIB1R04R217-EN									0	14	m	4					MK5KIBER04R217-EN;MK5XXLRR06R217-EN
17.		Project of Cyber Physics II*	MK5KIB2R06R217-EN													0	16	m	6	MK5KIBER04R217-EN;MK5XXLRR06R217-EN
18.		MSc Diploma Thesis I*	MK5DIP1R15RX17-EN									0	6	m	15					
19.		MSc Diploma Thesis II*	MK5DIP2R15RX17-EN													0	6	m	15	
	Criterium Subjects	Internship	MK5SZGYR00RX17-EN									4 weeks		s	0					
		Optional Subjects**					3												3	* The marked subjects are available in both semesters. In the third semester you are supposed to register for Project of Cyber Physics I and MSc Diploma Thesis I, in the fourth semester for Project of Cyber Physics II and MSc Diploma Thesis II.
		Physical Education		1 semester during the studies																
		Work and Fire Safety Course		Online course (can be taken in any semester)																
			Total:	12	14			8	16			2	30			2	26			
	State exam:		*Classes per week total:*	26				24				32				28				
	1. Elaborating tasks in writing (duration: 3 hours): Topic: Theories and Methods of Mechatronics. Questions are based on the material of the following courses: Spatial Mechanisms and Dynamical Systems; Electronics II; Embedded Systems along with all the courses of the selected specialization		*Credits:*				29				30				31				30	** Optional subjects according to Rules and Regulations of the Faculty: at least 6 credits (can be taken in any semester).
			Credits total:	120																
	2. Answers to questions related to the field of the diploma project. Candidates will have time for preparing drafts for the questions. Topics (3-5) will be provided after diploma submission.		*Exam:*			3				2				1				0		
			Mid-Semester Grade:			2				4				4				3		
	3. Diploma defence: submitted in writing. Presentation on diploma project; answers to questions, remarks in connection with the topic of the diploma.		Abbreviations: L= Lecture, P= Practice, E= Evaluation, C= Credits, e = exam, m = mid-semester grade, s= signature																	