University of Debrecen
Faculty of Engineering

Mechatronics Engineering BSc Program

2017
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DEAN’S WELCOME

Welcome to the Faculty of Engineering!
This is an exciting time for you, and I encourage you to take advantage of all that Faculty of Engineering UD offers you during your bachelor’s or master’s studies. I hope that your time here will be both academically productive and personally rewarding. Think creatively and be confident.

The Faculty of Engineering of the University of Debrecen is at the forefront of the education and training of engineers in the North-Great-Plain Region of Hungary. It is a dynamically developing Faculty with over 3000 students and a highly-qualified and enthusiastic teaching staff of about 80 members. We offer a great variety of BSc, MSc courses and post-graduate training courses tailored to suit the rapidly changing world of engineering and focusing on European and international trends.

In order to optimize the quality of training the Faculty continuously strives to expand the number of industry and educational partners at home and abroad.

The Faculty was awarded the Quality Prize in 2011 by the Ministry of Education as recognition of its efforts in this field.

I wish you every success in your studies and hope to meet you personally in the near future.

Best wishes,

Edit Szűcs
Dean
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 the University of Debrecen is classified as a “University of National Excellence” and offers the highest number of academic programmes in the country, hence it is one of the best universities in Hungary. Its reputation is a result of its quality training, research activities and the numerous training programmes in different fields of science and engineering in English. With 14 faculties and a student body of almost 30,000, of which about 3700 are international students, the University of Debrecen is one of the largest institutions of higher education in Hungary.

The history of the Faculty of Engineering dates back to 1965, when the Technical College was established. In 1972 it was named 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 aids the compatibility of the qualifications received at the University of Debrecen with universities all over Europe.

The Faculty of Engineering is practice oriented and develops skills required for the current conditions 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 with the help of the numerous prestigious domestic and multi-national industry partners. The internship periods are excellent opportunities for students to experience theory put into practice at the most renowned industry representatives and to become more successful in the labour market in this highly competitive sector. Students learn to operate in the working environment of multi-national companies and adapt to challenges easily. After graduation they will be able to operate at a strategic decision-making level, placing priority on efficiency and engineering ethics.

The Faculty of Engineering offers a great variety of BSc, MSc courses and post-graduate training courses tailored to suit the rapidly changing world of engineering and focusing on European and international trends. The Faculty of Engineering launched the engineering trainings in English in 2011. 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 the 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 of the most recent technical books, exhibitions and tea afternoons with invited speakers, but students can also purchase theatre and concert tickets here from the staff. The Borsos József dormitory is also a hub of activities for students.

The increasing number of foreign 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

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The Coordination Center for International Education supports the international degree programmes of University of Debrecen. It helps new students with information on admission and entrance exam. It serves promoting tasks and deals with several cases for students like enrolment, study contracts, modifying student status or major, activating student status, modifying students’ personal data, requiring student cards and their updating, modifications, providing certificates for the Immigration Office and registration to residential permit, certificates about student status, certificates on credit recognition, making health insurance contract and Health Insurance Card, requirement for visa.

STUDENT ADMINISTRATION CENTER

1, Egyetem Square, Debrecen H-4032 (basement of Kossuth Lajos Dormitory II)

This administration unit provides students in such cases like receiving new students, checking students’ FIR data, registration of tuition fees and other fees, transferring Stipendium Scholarship, handing out and certifying diploma information.

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The International Office has been functioning since 2014 in order to ensure that the international degree programmes achieves smoothly. The office has the tasks like arranging students’ study cases, providing certificates for students, accepting and considering requests, administration of late-coming students, solving problems of course registration, administration of Erasmus students, giving information about the Internship and the administration of transferred students.

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Department of Civil Engineering
Department of Electrical Engineering and Mechatronics
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</tr>
<tr>
<td>Name</td>
<td>Position</td>
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</tr>
<tr>
<td>Tamás Mankovits Ph.D.</td>
<td>Associate Professor, Head of Department</td>
</tr>
<tr>
<td>Lajos Dr. Fazekas Ph.D.</td>
<td>College Professor, Deputy Head of Department</td>
</tr>
<tr>
<td>Zsolt Tiba Dr. habil.</td>
<td>College Professor</td>
</tr>
<tr>
<td>Ms. Ágnes Battáné Gindert-Kele Ph.D.</td>
<td>Associate Professor</td>
</tr>
<tr>
<td>Levente Czégé Ph.D.</td>
<td>Associate Professor</td>
</tr>
<tr>
<td>György Juhász M.D.</td>
<td>Associate Professor</td>
</tr>
<tr>
<td>Sándor Bodzás Ph.D.</td>
<td>College Associate Professor</td>
</tr>
<tr>
<td>Sándor Hajdu Ph.D.</td>
<td>Senior Lecturer</td>
</tr>
<tr>
<td>Sándor Pálinkás Ph.D.</td>
<td>Senior Lecturer</td>
</tr>
<tr>
<td>Gábor Balogh</td>
<td>Assistant Lecturer</td>
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<td>Krisztián Deák</td>
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# ACADEMIC CALENDAR

General structure of an academic year:

<table>
<thead>
<tr>
<th>Study period</th>
<th>1st week</th>
<th>registration*</th>
<th>1 week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd – 7th week</td>
<td>teaching block 1</td>
<td>6 weeks</td>
<td></td>
</tr>
<tr>
<td>8th week</td>
<td>1st drawing week</td>
<td>1 week</td>
<td></td>
</tr>
<tr>
<td>9th – 14th week</td>
<td>teaching block 2</td>
<td>6 weeks</td>
<td></td>
</tr>
<tr>
<td>15th week</td>
<td>2nd drawing week</td>
<td>1 week</td>
<td></td>
</tr>
</tbody>
</table>

| Exam period | directly after the study period | exams | 7 weeks |

*Registration is in the first week of September in the fall semester usually, and in the first week of February in the spring semester.

# ACADEMIC CALENDAR OF THE FACULTY OF ENGINEERING 2017/2018

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening ceremony of the academic year</td>
<td>10th September 2017</td>
</tr>
<tr>
<td>1st semester registration week</td>
<td>From 4th September till 8th September 2017</td>
</tr>
<tr>
<td>Repeat period of exam courses announced for the 1st semester of the academic year 2017/2018</td>
<td>From 4th September till 8th September 2017</td>
</tr>
<tr>
<td>1st semester study period of MSc and BSc programme</td>
<td>From 11th September till 15th December 2017 (14 weeks). In case of finalist courses: from 11th September till 10th November 2017 (9 weeks).</td>
</tr>
<tr>
<td>1st semester study period of BSc dual programme</td>
<td>From 11th September till 8th December 2017 (13 weeks).</td>
</tr>
<tr>
<td>Reporting period (Drawing week) of MSc, BSc, and BSc dual programme</td>
<td>From 23rd October till 27th October 2017 (4 working days without scheduled lessons, consultation schedule announced previously).</td>
</tr>
<tr>
<td>Event</td>
<td>Details</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Reporting period (Drawing week, term for elaborating tasks apart from the finalist courses) of BSc programme</td>
<td>From 11\textsuperscript{th} December till 15\textsuperscript{th} December 2017 (5 working days without scheduled lessons, consultation schedule announced previously).</td>
</tr>
<tr>
<td>1\textsuperscript{st} semester exam period</td>
<td>From 18\textsuperscript{th} December 2017 till 2\textsuperscript{nd} February 2018 (7 weeks). From 13\textsuperscript{th} November till 15\textsuperscript{th} December 2017 (5 weeks) for graduating students</td>
</tr>
<tr>
<td>Deadline of submitting degree theses and dissertations</td>
<td>According to the decision of the departments but in 21 days in proportion to the first day of the final exam.</td>
</tr>
<tr>
<td>State exams (according to the decision of the departments)</td>
<td>At least one occasion in January 2018. The departments shall advertise the date of the final exam until 15\textsuperscript{th} September 2017.</td>
</tr>
<tr>
<td>2\textsuperscript{nd} semester registration week</td>
<td>From 5\textsuperscript{th} February till 9\textsuperscript{th} February 2017</td>
</tr>
<tr>
<td>2\textsuperscript{nd} semester study period of MSc and BSc programme</td>
<td>From 12\textsuperscript{th} February till 18\textsuperscript{th} May 2018 (14 weeks). In case of finalist courses: from 12\textsuperscript{th} February till 13\textsuperscript{th} April 2018 (9 weeks).</td>
</tr>
<tr>
<td>2\textsuperscript{nd} semester study period of BSc dual programme</td>
<td>From 20\textsuperscript{th} February till 19\textsuperscript{th} May 2018 (13 weeks).</td>
</tr>
<tr>
<td>Reporting period (Drawing week) of MSc, BSc and BSc dual programme</td>
<td>From 26\textsuperscript{th} March till 30\textsuperscript{th} March 2018 (5 working days without scheduled lessons, consultation schedule announced previously)</td>
</tr>
<tr>
<td>Reporting period (Drawing week, term for elaborating tasks apart from the finalist courses) of BSc programme</td>
<td>From 14\textsuperscript{th} May till 18\textsuperscript{th} May 2018 (5 working days without scheduled lessons, consultation schedule announced previously).</td>
</tr>
<tr>
<td>2\textsuperscript{nd} semester exam period</td>
<td>From 21\textsuperscript{st} May till 6\textsuperscript{th} July 2018 (7 weeks). From 16\textsuperscript{th} April till 18\textsuperscript{th} May 2018 (5 weeks) for graduating students.</td>
</tr>
<tr>
<td>Deadline of submitting degree theses and dissertations</td>
<td>According to the decision of the departments but in 21 days in proportion to the first day of the final exam.</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>State exams (according to the decision of the departments)</td>
<td>At least one occasion in June 2018. The departments shall advertise the date of the state exam until 15&lt;sup&gt;th&lt;/sup&gt; February 2018.</td>
</tr>
</tbody>
</table>
THE MECHATRONICS ENGINEERING UNDERGRADUATE PROGRAM

INFORMATION ABOUT THE PROGRAM

Name of undergraduate program: Mechatronics Engineering Undergraduate Program
Specialization available: Specialization in Mechatronic Systems
Field, branch: Engineering, mechanical, transportation, mechatronic engineering
Level: BSc
Qualification: Mechatronics Engineer
Mode of attendance: Full-time
Faculty: Faculty of Engineering
Program coordinator: Géza Husi PhD habil associate professor
Person in charge of the specialization: Géza Husi PhD habil associate professor
Program length: 7 semesters
Credits total: 210 credits

The objective of the programme is to train mechatronics engineers who has competence to integrate engineering with electronics, electrotechnics and computer control in synergetic way. They are able to complete routine design, operation and maintenance of mechatronics equipment and processes furthermore intelligent machinery, to introduce and apply mechatronics technologies, to organize energy-efficient and environmental process and production management, to complete average tasks on engineering development and design considering the needs of the international labour market. They are prepared to complete their studies in graduate programme.

Professional competences to be acquired

a) knowledge
He/She knows
- the applied materials and their production, characteristics in the field of mechatronics and the conditions of their application.
- the systems, sensors and actuators of mechatronics, electromechanical, information, motion control and their structural units, fundamental operation in engineering, in electrotechnics and in controlling.
- the fundamental design principles, methods in mechatronics including engineering and precision constructions and the fundamentals of designing analogue and digital circuits.
- the fundamental methods of calculation, modelling and simulation of engineering, electrical and control systems.
- the instruments, subassemblies, fundamental design and programming methods of computerized control, measurement data collection, embedded systems, optical detections, image processing
- the fundamental measurement procedures and their tools, equipment, measurement instruments applied in electronics and engineering.
- the domestic and international standards, regulations.
- the security, health and environment protection (SHE), common standards of quality management and controlling (QA/QC) related to his professional field.
- the fundamentals of the professional field, limits and requirements of logistics, management, environmental protection, quality assurance, occupational health, information technology, law, economics.
- the methods of learning, knowledge acquisition, data collection and their ethic limits, problem solving techniques.
- the basics of corporate finances and the methods and tools of cost-benefit analysis on the bases of engineering.

b) skills

He/She is able to
- apply basic calculations, modelling principles, methods in the field of engineering, electrotechnics and controlling related to designing products and technologies of mechatronics, electromechanics, movement control.
- understand and describe the structure, the operation of units and elements of mechatronic systems, the configuration and connection of system elements in engineering, electrotechnics and control technique.
- apply technical standards related to operating mechatronic systems and intelligent machines, the principles of adjusting and maintenance mechatronic systems in engineering, electrotechnic, controlling approaches and know their economical correspondences.
- control and check technological manufacturing processes bearing in mind the elements of quality control.
- diagnose errors, select the right error treatment in engineering, electrotechnic, control technique approaches.
- to integrate knowledge from the fields of electronic, engineering and informatics and systemic thinking with experts of different fields, to carry out professional negotiation, introduce his/her thoughts in his/her professional filed clearly both in written and oral forms.
- understand and use the proper online and printed literature in English and with this knowledge he/she keeps his/her professional development continuous.
- complete monotonous practical tasks with steadiness and tolerance.
- work in groups and accept his/her status in a group and identify with it.

c) attitude
He/she
- aspires to have an integrating role in connecting engineering, information, electrical engineering and life science.
- aspires to his/her self-learning in the field of mechatronics within that especially in applied engineering, electrical and informatics and other professional fields related to work in order to his/her self-learning will meet continuously with his/her professional goals.
- aspires to complete tasks to make management decisions preferably in cooperation with his/her colleagues opinions.
- is opened and receptive to applying new, modern, innovative procedures, methods especially in the field of organic farming, health consciousness.
- aspires to learn the best practical, new professional knowledge and methods.
- does his/her job under consideration with ethical standards.
- shares his/her experience with his/her colleagues to promote their development.

d) his/her autonomy and responsibility
He/she
- selects and applies the relevant problem solving methods individually.
- shall take responsibility for the statements and professional decisions indicated in designs and other documents, and for manufacturing procedures carried out under his/her control.
- shall become involved in projects of research and development related to his/her profession. In project groups he/she mobilizes his/her theoretical and practical knowledge and skills and cooperate with other group members to gain their aim in the project group.
- manages the work of staffing to which he is assigned, monitors the maintaining machines and instruments according to he instructions of his manager.
- evaluates the work effectiveness, efficiency and safety of his/her staff and as a leader he/she takes care of promoting his/her staff professional development and fosters their efforts. 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 Mechatronics Engineering BSc training:

Natural Sciences: 40-50 credits;
Economics and Humanities: 14-30 credits;
Field-specific professional skills for mechatronics engineers: 70-105 credits.

The specialization provided by the training institute comprises at least 40 credits in the complete bachelor program.

Minimum of credit points assigned to optional subjects: 10
Credit points assigned to thesis: 15
Credits total: 210

Guideline (List of Subjects/Semesters)

The total number of credit points (210) 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 Mechatronics Engineering BSc programme:
<table>
<thead>
<tr>
<th>1st semester</th>
<th>2nd semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics I</td>
<td>Mathematics II</td>
</tr>
<tr>
<td>Engineering Physics</td>
<td>Mathematics Comprehensive Exam</td>
</tr>
<tr>
<td>Informatics (Programming in C)</td>
<td>Computer-Aided Modelling</td>
</tr>
<tr>
<td>Electromagnetism</td>
<td>Materials Engineering</td>
</tr>
<tr>
<td>Law and Ethics</td>
<td>Economics for Engineering</td>
</tr>
<tr>
<td>Basics of Mechatronics</td>
<td>Informatics (Labview)</td>
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<tr>
<td></td>
<td>Electrotechnics</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>3rd semester</th>
<th>4th semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics III</td>
<td>Dynamics and Vibration</td>
</tr>
<tr>
<td>Statics and Strength of Materials</td>
<td>Mechatronic Devices (Sensors, Actuators, Motors)</td>
</tr>
<tr>
<td>Microeconomics and economical processes of enterprises</td>
<td>Measurement and data acquisition</td>
</tr>
<tr>
<td>Electronics I</td>
<td>Environment, Health and Safety, Ergonomics (Basics of EHS)</td>
</tr>
<tr>
<td>Mechanical Machines and Machine Elements</td>
<td>Applied Automatization I</td>
</tr>
<tr>
<td>Manufacturing Technologies</td>
<td>Pneumatics and Hydraulics</td>
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<table>
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<tr>
<th>5th semester</th>
<th>6th semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality and Technical Management</td>
<td>Electrical machines and drives</td>
</tr>
<tr>
<td>Applied Automatization II</td>
<td>Thermodynamic Processes</td>
</tr>
<tr>
<td>Electropneumatics and Electrohydraulics</td>
<td>Mechatronics Comprehensive Exam</td>
</tr>
<tr>
<td>Modelling and Simulation Prototype Technologies I</td>
<td>Modelling and Simulation Prototype Technologies II</td>
</tr>
<tr>
<td>Robots and Robotics Technology</td>
<td>Caxx Techniques</td>
</tr>
<tr>
<td></td>
<td>Cyber-Physical Systems</td>
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</tbody>
</table>

<table>
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<tr>
<th>7th semester</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Project of Mechatronics</td>
<td></td>
</tr>
<tr>
<td>BSc Thesis</td>
<td></td>
</tr>
</tbody>
</table>
About the prerequisites of each subject please read the chapter “Course Descriptions for Mechatronics Engineering BSc”!

Work and Fire Safety Course

According to the Rules and Regulations of University of Debrecen a student has to complete the online course for work and fire safety. 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 Mechatronics Engineering BSc have to carry out a 6 weeks 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 (4th semester). Its execution is the criteria requirement of getting the pre-degree certificate (absolutorium).

Physical Education

According to the Rules and Regulations of University of Debrecen a student has to complete Physical Education courses at least in two semesters during his/her Bachelor 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 BSc 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 Mechatronics Engineering BSc programme you have to gain at least 10 credits with completing elective subjects.

Pre-degree Certification

A pre-degree certificate is issued by the Faculty after completion of the bachelor (BSc) program. The pre-degree certificate can be issued if the student has successfully completed the study and exam requirements as set out in the curriculum, the requirements relating to Physical Education, internship (mandatory) – with the exception of preparing thesis – and gained the necessary credit points (120). The pre-degree certificate verifies (without any mention of assessment or grades) that the student has fulfilled all the necessary study and exam requirements defined in the curriculum and the requirements for Physical Education. Students who obtained the pre-degree certificate can submit the thesis and take the final exam.

Thesis

A Thesis is the creative elaboration of a professional task (scientific, engineering, design, development, research or research development) in written form. By solving the task the student relies on his/her studies using national and international literature under the guidance of an internal and 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. By preparing and defending thesis students who complete the Mechanical Engineering undergraduate program prove that they are capable of the practical applications of the acquired skills, summarizing the work done and its results in a professional way, creatively solving the tasks related to the topic and doing individual professional work. The faculty academic calendar (issued by the Vice-Rector for Education) sets the thesis submission deadline.

A student in bachelor program has to make a thesis as a prerequisite of the state 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 mechatronics engineering program the credits assigned to the thesis is 15.
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. Furthermore, it is necessary that the committee of the Pre-NCSSA makes suggestions on the NCSSA work to become a thesis.

Making a thesis is controlled by a supervisor had approved by the department who is promoted by a referee also previously had approved by the department. Formal requirements of a thesis are announced in writing by the Department of Electrical Engineering and Mechatronics that are announced with the tasks in written form at the same time.

The faculty academic calendar (issued by the Vice-Rector for Education) sets the thesis submission deadline, for want of this the deadline is the 21. day 12 noon before the first day of the final exam.

Thesis is evaluated by the referee (internal or external), and it is evaluated and qualified individually by the 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.

State Exam (Final Exam)

Students having obtained the pre-degree certificate will finish their studies by taking the final exam. 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. Only students who do not have outstanding charges are 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.

A student having obtained the pre-degree certificate (absulotorium) will finish his/her studies in Mechatronics Engineering BSc training by taking the state exam. A state exam is the evaluation and control of the knowledge and skills acquired in tertiary education during which the candidate has to certify that he/she is able to apply the obtained knowledge in practice.
A state exam can be taken in the forthcoming exam period after obtaining the pre-degree certificate. The Department announces two state exam dates in a year, one at the beginning of January and one at the end of June. A state exam have to be taken in front of the Committee on the fixed date. If a candidate does not pass his/her state exam by the termination of his/her student status, he/she can take his/her state exam after the termination of the student status on any of the state exam days of the relevant academic year according to existing requirements on the rules of the state exam.

The State Exam consists of two parts according to the curriculum.

1) Written and oral exam on the topics of Building Automation.
2) Thesis Defence (a presentation of the thesis, answering questions, comments then answering questions based on the knowledge related to the thesis topic)

A state exam can be started if the candidate can be submitted to the state exam on the basis of definite opinion of the referees. The two parts must be hold on the same day.

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

*Improving failed state exam*

If a thesis is evaluated with a fail mark by the Final Exam Board a final exam has to be retaken with a new or modified thesis.

If any of part if the final exam is a fail it must be retaken according to the existing rules of the university. Final exam can be retaken twice. The ensuing final exam period is the soonest that the re-sit is allowed.

*Final exam board*

Committee chair and members of the committee are 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) and
the examiner. 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.
COURSE DESCRIPTIONS FOR MECHATRONICAL ENGINEERING BSC

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

Subject group “Basic Natural Sciences”

Mathematics I

Code: MK3MAT1A8RX17-EN
ECTS Credit Points: 8
Evaluation: mid-semester grade
Year, Semester: 1st year, 1st semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 4+4

Topics:
The basic notions of linear algebra, differentiation and integration for real functions; some applications in physics.

Literature:
Compulsory:

Schedule

<table>
<thead>
<tr>
<th>1st week</th>
<th>Registration week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd week:</td>
<td>Lecture: Real numbers</td>
</tr>
<tr>
<td></td>
<td>Axiom system. Boundary, inf, sup, min, max. Dedekind-complete, real line. Distance, neighbourhood, interior point, accumulation point. Intervals. The sets ( \mathbb{R} ), ( \mathbb{R}^2 ), ( \mathbb{R}^3 ) and their geometric interpretations. Natural numbers, integer numbers, rational numbers. Coordinate systems Polar</td>
</tr>
<tr>
<td>3rd week:</td>
<td>Lecture: Sequences of real numbers and their limit. The notion of real sequences. Limits and operations. Some important sequences and their properties. Monotone and bounded sequences. Practice: Vector geometry, vector algebra. The algebra of vectors in 2 and 3 dimensions: operations, coordinate systems. The algebraic definition of the</td>
</tr>
</tbody>
</table>
coordinate system. Spherical- and Cylindrical coordinate systems.

**Practice:** Operations of sets, Boole algebra. Logic values, logic operations, logic functions. Cartesian product, 2-tuple, n-tuple. Cardinality. Illustrations of sets on the plane and in the space.

**4th week:**

**Lecture:** Series of real and complex numbers. Partial sums and convergence. Absolute convergence. Geometric series, criteria of convergence. (Comparison test, ratio test, root test).

**Practice:** Applications: Mechanical work, moment of a force with respect to a point, moment of a force with respect to an axis.

**6th week:**

**Lecture:** Approximations of real functions. Lagrange interpolation. Linear regression.

**Practice:** The set of thee complex numbers. Complex plane, rectangular form, trigonometric form, exponential form, operations.

Application: complex impedance

**8th week: 1st drawing week Test 1**

**9th week:**

**Lecture:** Matrices. The arithmetic of matrices, determinants and their properties: operations, the notions of symmetrical matrix, skew-symmetrical matrix, determinant, the inverse matrix.

**Practice:** Matrices. Operations, determinants and inverses with adjoint matrices

**11th week:**

**12th week:**

cross product. Geometric interpretations of the scalar product and the cross product. The mixed product.

**5th week:**

**Lecture:** Series of real functions. The notion of series of real functions, the convergence domain, the radius of the convergence. Power series. Power series of some elementary functions.

**Practice:** Vector geometry, vector algebra. Unit vector in the direction of a vector, projections. Geometric applications: lines and planes in the space. The area of a triangle, the volume of a tetrahedron. The distance between a point and a line, or between a point and a plane.

**7th week:**

**Lecture:** Summary, sample test

**Practice:** Sequences of real numbers. Limits and operations. Monotone and bounded sequences, convergence and relations among them.

**10th week:**

**Lecture:** Vector spaces. The notion of linear (or vector) space, linear combinations of vectors, linearly dependent and independent systems, basis, dimension, coordinates. Ranks of vector systems, ranks of matrices

**Practice:** Vector spaces. Linearly independent and dependent systems, bases. Ranks of vector systems, ranks of matrices

**12th week:**
Lecture: Systems of linear equations: Gauss elimination (addition method) and Cramer’s rule. Applications: Calculations for direct current using Kirchhoff’s current and voltage laws.

Practice: Systems of linear equations: Gauss elimination (addition method) and Cramer’s rule.

13th week:
Lecture: Linear functions. The notion of the linear function, the matrices of linear functions. Eigenvalues, eigenvectors.


15th week: 2nd drawing week Test

Requirements
A, for a signature:
Participation at practice, according to Rules and Regulations of University of Debrecen. The correct solution of homework and submission before deadline. Solving assorted tasks.

B, for a grade:
All the tests must be written during the semester. Evaluation is according to the Rules and Regulations of University of Debrecen.

Mathematics II

Code: MK3MAT2A6RX17-EN
ECTS Credit Points: 6
Evaluation: mid-semester grade
Year, Semester: 1st year, 1st semester
Its prerequisite(s): Mathematics I
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+4

Topics:
Differentiation and integration of multivariable and vector-valued functions, differential equations.

**Literature:**

*Compulsory:*


**Schedule**

<table>
<thead>
<tr>
<th>1st week Registration week</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2nd week:</strong></td>
</tr>
<tr>
<td><strong>Lecture:</strong> Metric, topology, sequences in $\mathbb{R}^n$. Linear functions.</td>
</tr>
</tbody>
</table>

| 3rd week:                  |
| **Lecture:** Parametric curves I. Notions of differentiation, linear approximation. Frenet-Serret frame. Some examples in physics |
| **Practice:** Differentiation, linear approximation, tangent line. Applications: velocity, acceleration. Problems leading to differential equations. (Newton’s second law, RLC, examples in economics). |

| 4th week:                  |
| **Lecture:** Parametric curves II. Curvature, torsion. Evolute, evolvent, conic sections. |
| **Practice:** Curvature, torsion. Determinations of conic sections in parametric form. Differential equations which can be integrated on direct way. Separable differential equations. |

| 5th week:                  |
| **Lecture:** Differentiable functions of type $\mathbb{R}^n \rightarrow \mathbb{R}^m$. |
| **Practice:** Derivatives of functions of type $\mathbb{R}^n \rightarrow \mathbb{R}^m$. First order linear differential equations (homogeneous and inhomogeneous, method of variation). |

| 6th week:                  |
| **Lecture:** Parametric surfaces. Tangent plane, linear approximation. Surfaces of revolution, ruled surfaces. |
| **Practice:** Surfaces of revolution: ellipsoid and paraboloid in parametric form. Derivatives of functions of type $\mathbb{R}^2 \rightarrow \mathbb{R}^3$. The equation of the tangent plane. |

| 7th week:                  |
| **Lecture:** Scalar field, gradient. Young’s theorem. Directional derivative. |
| **Practice:** The domains of functions of type $\mathbb{R}^2 \rightarrow \mathbb{R}$. Directional derivative and gradient. Higher order linear differential equations, Wronski determinant. |
Determination of solutions of inhomogeneous first order linear differential equations

8th week: 1st drawing week Test 1,2

9th week:
Lecture: Local and global extrema.
Practice: Local extremas of functions of type.
\[ \mathbb{R}^2 \to \mathbb{R}, \mathbb{R}^3 \to \mathbb{R} \]

10th week:
Practice: Determination of global extremas on boundary closed sets. Solution of linear homogeneous differential equations of order two having constant coefficients.

11th week:
Lecture: The notion of double and triple integrals on 2 and 3 dimensional intervals. The extensions of the integrals.

12th week:
Lecture: Integrals over general regions. Applications: second moment of area, mass, center of gravity
Practice: Double and triple integrals on 2 and 3 dimensional intervals. Special second order differential equations.

13th week:
Lecture: The arc length of curves, surface area. Line and surface integrals. The theorems of Gauss and Stokes, Green’s formulae. Applications in physics.
Practice: Integrals over general regions. Applications: second moment of area, mass, center of gravity. The theorems of Gauss and Stokes, Green’s formulae. Applications in physics. The Laplace transform and its applications.

14th week:
Lecture: Mathematical softwares
Practice: The arc length of curves, surface area. Line and surface integrals. Slope fields, numerical methods. (Euler, Runge-Kutta).

15th week: 2nd drawing week Test 3, 4

Requirements
A, for a signature:
Participation at practice, according to Rules and Regulations of University of Debrecen. The correct solution of homework and submission before deadline. Solving assorted tasks.

B, for a grade:
All the tests must be written during the semester. Evaluation is according to the Rules and Regulations of University of Debrecen.
Mathematics Comprehensive Exam

Subjects of the comprehensive exam: Mathematics I and II

Mathematics III

Code: MK3MAT3A04RX17-EN
ECTS Credit Points: 4
Evaluation: mid-semester grade
Year, Semester: 2nd year, 1st semester
Its prerequisite(s): Mathematics II
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:

Literature:
Compulsory:
- 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

Schedule

1st week Registration week

2nd week:
Lecture: Sample spaces and events. Axioms of probability.
Practice: Calculation of probability.

3rd week:
### 4th week:
**Lecture:** Discrete and continuous random variables, probability distribution, density function.
**Practice:** Random variables.

### 6th week:
**Lecture:** Numerical characteristics of random variables.
**Practice:** Numerical characteristics of random variables.

### 8th week: 1st drawing week Test 1

### 9th week:
**Lecture:** Binomial, Poisson, uniform, exponential, Weibull and normal distribution, applications.
**Practice:** Random variables.

### 11th week:
**Lecture:** Sampling, descriptive statistics. SPC.
**Practice:** Descriptive statistics.

### 10th week:
**Lecture:** Numerical solution methods.
**Practice:** Numerical solution methods.

### 12th week:
**Lecture:** Modelling with differential equations. Linear systems.
**Practice:** Modelling with differential equations.

### 14th week:
**Lecture:** Non-homogeneous linear differential equations, applications.
**Practice:** Non-homogeneous linear differential equations.

### 15th week: 2nd drawing week Test 2

### Requirements

**A, for a signature:**
Participation at practice, according to Rules and Regulations of University of Debrecen. The correct solution of homework and submission before deadline. Solving assorted tasks.

**B, for a grade:**
All the tests must be written during the semester. Evaluation is according to the Rules and Regulations of University of Debrecen.
Engineering Physics

Code: MK3MFIZA04RX17-EN
ECTS Credit Points: 4
Evaluation: exam
Year, Semester: 1st year, 1st semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:
Geometrical optics, kinematics and dynamics of particles, concept of mechanical work, kinetic and potential energy, electrostatics, electric fields around conductors, transport processes, steady-state transport of electric charge, steady-state heat transfer (conduction, convection and radiation)

Literature:
Compulsory:
- Jerry S. Faughn, Raymond A. Serway, Chris Vuille, Charles A. Bennett: Serway’s College Physics, Published 2005 by Brooks Cole Print, ISBN 0-534-99723-6

Schedule

<table>
<thead>
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<th>1st week Registration week</th>
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</table>

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Lecture:</strong> Geometrical (ray) optics.</td>
</tr>
<tr>
<td>Concept of geometrical optics, law of reflection and refraction (Snell’s law), Brewster’s angle, Optics of prisms and lenses, imaging properties and magnification, aberrations, compound lenses.</td>
</tr>
<tr>
<td><strong>Practice:</strong> Solving problems for the reflection and refraction of light beams and for the imaging of lenses and compound lenses.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3rd week:</th>
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</thead>
<tbody>
<tr>
<td><strong>Lecture:</strong> Kinematics of a particle I.</td>
</tr>
<tr>
<td>Description of the motion by scalar quantities: Scalar position, velocity and acceleration.</td>
</tr>
<tr>
<td>Example: uniform and uniformly varying motion</td>
</tr>
<tr>
<td><strong>Practice:</strong> Solving problems for uniform and uniformly varying motions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4th week:</th>
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<tbody>
<tr>
<td><strong>Lecture:</strong> Kinematics of a particle II.</td>
</tr>
<tr>
<td>Description of the motion by vector</td>
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</tbody>
</table>

<table>
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<tr>
<th>5th week:</th>
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<tbody>
<tr>
<td><strong>Lecture:</strong> Kinetics of a particles I. Inertial frame of reference, Newton’s Laws, force</td>
</tr>
</tbody>
</table>
quantities: Position vector, vector velocity and acceleration.

Example: throwing problems, circular motion.

**Practice:** Solving throwing and circular motion problems.

6th week:
**Lecture:** Kinetics of a particles II. Concept of work and kinetic energy, work-energy theorem. Application of work-energy theorem in dynamic problems.

**Practice:** Application of Newton’s laws and the work energy theorem in kinetic problems.

8th week: 1st drawing week Test 1

9th week:
**Lecture:** Electrostatics II. Electric voltage and potential, capacitance, capacitance of planar, cylindrical and spherical capacitors, the energy of capacitors, capacitor circuits.

**Practice:** Calculating the capacitance and stored energy of different types of capacitors and capacitor connections.

11th week:
**Lecture:** Steady state transport of electric charge (Direct electric current). Electric current intensity, electrical conductivity and resistance, Ohm’s law, electric work and power, characteristics of DC sources, Kirchhoff’s circuit laws, solution of DC circuits

**Practice:** Solution of DC circuits

13th week:
**Lecture:** Steady-state heat transfer II - Thermal convection. Concept of thermal


**Practice:** Application of Newton’s laws in kinetic problems.

7th week:
**Lecture:** Electrostatics I. Electric field strength and flux, Gauss’s law for electricity (Maxwell’s first equation), potential energy in electric fields.

**Practice:** Calculation of the electric field strength and its flux in the electrostatic fields of different charge arrangements.

10th week:
**Lecture:** Transport processes

Concept of physical system, current intensity and source strength, extensive and intensive physical properties, conduction and convection current. Equation of balance and steady-state conduction. Thermal conductivity and conductive resistance. Conductive resistance circuits.

**Practice:** Application of the equation of balance and steady-state conduction in different physical problems.

12th week:
**Lecture:** Steady-state heat transfer I - Thermal conduction. Concept of heat current and thermal conduction, equation of steady-state thermal conduction, thermal conductivity and resistance, steady state temperature distribution in a one dimensional wall of thermal conductivity

**Practice:** Solving thermal conduction problems

14th week:
**Lecture:** Steady-state heat transfer III - Thermal radiation. Thermal radiation
convection and heat transfer, equation of steady-state heat transfer, heat transfer coefficient and resistance, overall heat transfer coefficient and resistance

**Practice:** Calculating the steady state temperature distribution in a one dimensional wall of thermal conductivity.

characteristics, concept of black body radiation, fundamental laws of thermal radiation (Planck distribution, Wien displacement law, Stefan-Boltzmann and Kirchhoff's law), gray body radiation

**Practice:** Solving thermal radiation problems.

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**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 table below:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Score Range</th>
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</thead>
<tbody>
<tr>
<td>Fail (1)</td>
<td>0-39</td>
</tr>
<tr>
<td>Close fail (2)</td>
<td>40-50</td>
</tr>
<tr>
<td>Improvement needed (3)</td>
<td>51-60</td>
</tr>
<tr>
<td>Very good (4)</td>
<td>61-70</td>
</tr>
<tr>
<td>Excellent (5)</td>
<td>71-80</td>
</tr>
</tbody>
</table>

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:**

Everybody will get an exam grade for their exam. 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).

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**Computer Aided Modelling**

Code: MK3SZABA04RX17-EN
ECTS Credit Points: 4
Evaluation: mid-semester grade
Year, Semester: 1st year, 2nd semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 0+4

Topics:
Computer-aided geometric design deals with the description of shape for use in computer graphics. The aim of this course is to develop the spatial ability - which is essential in engineering applications -, the 3D representation and the techniques of graphic communication with use of computer-aided de-sign (CAD) software. Basics of plane geometry. Computer-aided geometric constructions. Representation of solids, sizing, plane transformation, intersections. Plane curves, splines. Basics of spatial geometry. 3D loci. 3D constructions. Intersection of the polyhedrons with lines and planes. Intersection of two polyhedrons. Space curves, curved surfaces, ruled surfaces, surface of revolution. Representation of curved surfaces, Intersection of curved surfaces with planes. Intersection of two curved surfaces. Solid modelling, 3D construction, construction and representation of geometric elements with given conditions.

Literature:
Compulsory:

Schedule

<table>
<thead>
<tr>
<th>1st week</th>
<th>Registration week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd week:</td>
<td>Practice: Representation of the space-elements (points, lines, segments, planes). Line in a plane, point in a plane. Basics of spatial geometry.</td>
</tr>
<tr>
<td>3rd week:</td>
<td>Practice: Intersection of the polyhedrons with lines and planes. Prisms and pyramids.</td>
</tr>
<tr>
<td>4th week:</td>
<td>Practice: Intersection of two polyhedrons. Intersection of prisms and pyramids.</td>
</tr>
<tr>
<td>5th week:</td>
<td>Practice: Curved surfaces (Cylinders, Cones, Spheres). Intersection of the Curved surfaces with planes. Development of a curved surfaces and intersections.</td>
</tr>
<tr>
<td>Week</td>
<td>Practice</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>6th</td>
<td>Practice: Computer-aided geometric constructions. Representation of solids,</td>
</tr>
<tr>
<td></td>
<td>sizing, plane transformation, intersections.</td>
</tr>
<tr>
<td>7th</td>
<td>Practice: Plane curves, splines.</td>
</tr>
<tr>
<td>8th</td>
<td>1st drawing week</td>
</tr>
<tr>
<td>9th</td>
<td>Practice: Spatial geometry, 3D loci.</td>
</tr>
<tr>
<td>10th</td>
<td>Practice: 3D constructions. Intersection of the polyhedrons with lines and</td>
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<td></td>
<td>planes. Intersection of two polyhedrons.</td>
</tr>
<tr>
<td>11th</td>
<td>Practice: Space curves, curved surfaces, ruled surfaces, surface of revolution.</td>
</tr>
<tr>
<td>12th</td>
<td>Practice: Representation of curved surfaces. Intersection of curved surfaces</td>
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<tr>
<td></td>
<td>with planes. Intersection of two curved surfaces.</td>
</tr>
<tr>
<td>13th</td>
<td>Practice: Solid modelling I. 3D construction, construction and representation of geometric elements with given conditions.</td>
</tr>
<tr>
<td>14th</td>
<td>Practice: Solid modelling II. 3D construction, construction and representation of geometric elements with given conditions.</td>
</tr>
<tr>
<td>15th</td>
<td>2nd drawing week</td>
</tr>
</tbody>
</table>

Requirements

A, for a signature:
Regular attendance (Minimum 70%). Successful accomplishment of homeworks.

B, for grade:
Grades will be a composite of mid-term test and end-term test. Minimum requirements to pass the semester: Successful accomplishment of the tests (Minimum 50%).

Informatics (Programming in C)

Code: MK3INFCA4RX17-EN
ECTS Credit Points: 4
Evaluation: mid-semester grade
Year, Semester: 1st year, 1st semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 0+4
Topics:

Literature:

Compulsory:

Schedule

1st week Registration week

2nd week:
Practice: Basic knowledge. Phases of programming, problem orientation, specification, algorithm design, control modes, structural chart, flowchart, source code, object Code, development environment, compiler

3rd week:
Practice: Types, Operators and Expressions. Number representation, data types, abstract data type, elemental data types, complex data types, string type, type creation, dynamic variables, memory model, modules, define and declare variables in C.

4th week:
Practice: Pointers and Arrays. Arrays, vectors and matrices, array management, matrix operations

5th week:
Practice: Dynamic variables. Memory management, pointer type, pointer arithmetic

6th week:
Practice: Control structures. Logical conditions, Boolean algebra, selection controls: simple selection, multiple selection, case selection, implementation in C.

7th week:
Practice: Control structures. Repeat controls: initial condition, termination, counting, loop, discrete loop, implementation in C.

8th week: 1st drawing week, Test 1

9th week:
Practice: Functions and program structure

10th week:
Practice: Functions and program structure. Process control, void and function
Sequential control and implementation in C language.

11th week:
Practice: Structures. Implementing structures, complex programming tasks

13th week:
Practice: Input/Output Operation. Basics of I/O operations, access to data files, low level and formatted I/O operations

15th week: 2nd drawing week, Test 2

Requirements
Participation at practice, according to Rules and Regulations of University of Debrecen. The correct solution of homework and submission before deadline. Solving assorted tasks.

Electromagnetism

Code: MK3EMAGA04RX17-EN
ECTS Credit Points: 4
Evaluation: exam
Year, Semester: 1st year, 1st semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:
Electrostatics, electrical potential, electric fields around conductors, electric current, the fields of moving charges, the magnetic field, electric and magnetic fields in matter, electromagnetic induction and Maxwell’s equations, alternating-current circuits, electromagnetic waves.

Literature:
Compulsory:
Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; week</td>
<td>Registration week</td>
<td></td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; week</td>
<td>Lecture: Coulomb’s law. Electric field strength and its flux. Gauss’s law for electricity (Maxwell’s first equation)</td>
<td>Practice: Calculation of the strength of static electric fields generated by simple charge arrangements.</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; week</td>
<td>Lecture: Potential energy in static electric field and its calculation in simple cases. Electric potential and voltage. Capacitance. Capacitance of a planar, spherical and cylindrical capacitor.</td>
<td>Practice: Calculation of potential energy and voltage in static electric fields.</td>
</tr>
<tr>
<td>4&lt;sup&gt;th&lt;/sup&gt; week</td>
<td>Lecture: Capacitor circuits. Energy stored in a capacitor. Electric field in matter.</td>
<td>Practice: Calculation of the capacitance and energy of different types of capacitors and capacitor connections</td>
</tr>
<tr>
<td>6&lt;sup&gt;th&lt;/sup&gt; week</td>
<td>Lecture: The magnetic field: Lorentz force, magnetic induction and its flux. Gauss’s law for magnetism. (Maxwell’s second equation) Ampere’s circuital and Biot-Savart law and their application for the calculation of magnetic induction in simple cases.</td>
<td>Practice: Calculation of the force acting on a moving charged particle in a magnetic field. Calculation of magnetic induction in a magnetic field generated by current carrying wires.</td>
</tr>
<tr>
<td>7&lt;sup&gt;th&lt;/sup&gt; week</td>
<td>Lecture: Waste Management</td>
<td></td>
</tr>
<tr>
<td>8&lt;sup&gt;th&lt;/sup&gt; week</td>
<td>Lecture: Electromagnetic induction: Faraday’s law of induction and generalized</td>
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</tr>
<tr>
<td></td>
<td>1&lt;sup&gt;st&lt;/sup&gt; drawing week, Test 1</td>
<td></td>
</tr>
<tr>
<td>9&lt;sup&gt;th&lt;/sup&gt; week</td>
<td>Lecture: Electromagnetic induction: Faraday’s law of induction and generalized</td>
<td></td>
</tr>
<tr>
<td>10&lt;sup&gt;th&lt;/sup&gt; week</td>
<td>Lecture: Occupational Safety</td>
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</tbody>
</table>

Practice: Calculation of the voltage induced in a loop and in different types of coils. Calculation of the self and mutual inductance of coils.

11th week: Labor and Health
Lecture: Concept and characteristics of alternating current and voltage, inductive and capacitive reactance. Power in AC circuits.
Practice: Calculations in AC circuits.

13th week:
Lecture: Characteristics of electromagnetic waves (wave number and length, intrinsic impedance, polarization, propagation constant). Reflection and transmission of plane electromagnetic waves at plane boundaries.
Practice: Calculation of the characteristics of electromagnetic waves. Solving problems of reflection and transmission of plane electromagnetic waves at plane boundaries.

15th week: 2nd drawing week, Test 2

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 table below:

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<td>40-50</td>
</tr>
<tr>
<td>Improvement needed (3)</td>
<td>51-60</td>
</tr>
</tbody>
</table>

Practice: Solving problems in connection with AC generators and transformers.

12th week:
Lecture: Analyzing AC circuits with complex numbers.
Practice: Analyzing AC circuits with complex numbers.

14th week:
Lecture: Propagation of electromagnetic field along transmission lines
Practice: Solving electromagnetic wave propagation problems.
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).

### Statics and Strength of Materials

**Code:** MK3STSZG04XX17-EN  
**ECTS Credit Points:** 4  
**Evaluation:** mid-semester grade  
**Year, Semester:** 2nd year, 1st semester  
**Its prerequisite(s):** Engineering Physics  
**Further courses are built on it:** Yes/No  
**Number of teaching hours/week (lecture + practice):** 2+2

**Topics:**


**Literature:**

*Compulsory:*


Recommended:


## Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st week</td>
<td>Registration week</td>
</tr>
<tr>
<td>2nd week</td>
<td>Lecture: Mathematical preliminaries (vector-, matrixalgebra). Introduction to engineering mechanics. Statics of a particle. Practice: Calculation the resultant of 2 and 3 dimensional force systems acting on particles.</td>
</tr>
<tr>
<td>4th week</td>
<td>Lecture: Statics of planar structures. Supports and reaction forces. Practice: Practical examples for the determination of the reaction forces of statically determined structures.</td>
</tr>
<tr>
<td>6th week</td>
<td>Lecture: Determination of stress resultant diagrams of beams. Practice: Practical examples for the determination of the normal force, shear force and bending moment diagrams of beams.</td>
</tr>
<tr>
<td>8th week</td>
<td>1st drawing week</td>
</tr>
<tr>
<td>5th week</td>
<td>Lecture: Internal force systems of rigid bodies. Loading of beams. Practice: Practical examples for the determination of the normal force, shear force and bending moment functions of beams.</td>
</tr>
<tr>
<td>7th week</td>
<td>Lecture: Statically determined beam structures. Practice: Analysis of hinged-bar systems and truss systems. 1st test.</td>
</tr>
</tbody>
</table>
9th week:
Practice: Practical examples for strain and stress calculations.

10th week:
Practice: Practical examples for tension, compression and bending.

11th week:
Lecture: Simple loadings II: torsion of prismatic beams with circular and ring cross sections. Mohr’s circle. Shear.
Practice: Practical examples for torsion and shear.

12th week:
Lecture: Combined loadings I: tension and bending, inclined bending, excentrical tension.
Practice: Practical examples for combined loadings.

13th week:
Lecture: Combined loadings II: tension and torsion, bending and torsion. Sizing methods.
Practice: Practical examples for combined loadings.

14th week:
Lecture: The finite element method.
Practice: Case studies for numerical calculation of engineering structures. 2nd test.

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 14th week. Students have to sit for the tests.

B, for a grade:
The course ends in a mid-semester grade (AWS) 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 table:

<table>
<thead>
<tr>
<th>Score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-39</td>
<td>fail (1)</td>
</tr>
<tr>
<td>40-52</td>
<td>pass (2)</td>
</tr>
<tr>
<td>52-63</td>
<td>satisfactory (3)</td>
</tr>
<tr>
<td>64-71</td>
<td>good (4)</td>
</tr>
<tr>
<td>72-80</td>
<td>excellent (5)</td>
</tr>
</tbody>
</table>

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.

**Dynamics and Vibrations**

Code: MK3MREZG04XX17-EN  
ECTS Credit Points: 4  
Evaluation: mid-semester grade  
Year, Semester: 2nd year, 2nd semester  
Its prerequisite(s): Engineering Physics  
Further courses are built on it: Yes/No  
Number of teaching hours/week (lecture + practice): 2+2  

**Topics:**  
Motion of a particle:  
position, velocity and acceleration and the mathematical relations between them, description of the motion of the particle in Cartesian coordinate system and Frenet-frame, Newton’s laws and differential equation of the motion of the particle, theorems of kinetics, force fields, kinetic, potential and mechanical energy, constrained motion along a two or three dimensional curve  
Motion of a rigid body:  
description of the translational, rotational and general plane motion of a rigid body, concept and determination of the instantaneous centre of zero velocity and acceleration, rolling motion without slipping, description of the plane motion of a rigid body in a time interval, centre of mass, momentum and angular momentum, moment of inertia and its calculation, mechanical work, Newton’s laws and theorem of kinetics for rigid bodies, rotating and swinging of the body about an axis, rolling without slipping  
Vibrations:

**Literature:**

**Compulsory:**


**Recommended:**


**Schedule**

<table>
<thead>
<tr>
<th>1st week Registration week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd week:</td>
</tr>
<tr>
<td><strong>Lecture: Kinematics of a particle</strong></td>
</tr>
<tr>
<td>Scalar and vector position, velocity and acceleration and the mathematical relations between them. Description of the motion in Cartesian coordinate system and Frenet-frame. Special motion types: Motion with constant acceleration, circular motion.</td>
</tr>
<tr>
<td>3rd week:</td>
</tr>
<tr>
<td><strong>Lecture: Kinetics of a particle I</strong></td>
</tr>
</tbody>
</table>
Practice: Particle kinematics problems

4th week:
Lecture: Kinetics of a particle II
Formulas for work and potential energy in homogeneous and central force fields. Motion of the particle in gravitational and elastic spring force fields. Constrained motion along a two or three dimensional curve.

Practice: Particle kinetics problems II

5th week:
Lecture: Kinematics of a rigid body I
Basic concepts (rigid body and disc, planar, translational, rotational and general plane motion). Connections between the velocity and acceleration of the different points of a rigid body undergoing translational, rotational and general plane motion. Instantaneous centre of zero velocity and acceleration and procedure for the determination of them with calculation and construction.

Practice: Rigid body kinematics problems

6th week:
Lecture: Kinematics of a rigid body II
Rolling motion without slipping. Description of the plane motion of a rigid body in a time interval. Pole curves.

Practice: Rigid body kinematics problems

7th week:
Lecture: Kinetics of a rigid body I
Basic concepts: centre of mass, momentum and angular momentum, moment of inertia and its calculation, parallel axis theorem, mechanical work.

Practice: Rigid body kinetics problems

8th week: 1st drawing week

9th week:
Lecture: Kinetics of a rigid body II
Newton’s laws and theorem of kinetics for rigid bodies (impulse-momentum, angular impulse-angular momentum and work-energy theorems). Special motion types: Rotating and swinging about an axis, rolling without slipping.

Practice: Rigid body kinetics problems

10th week:
Lecture:
Description and classification of vibratory motions and vibrating systems. Basic definitions and properties of vibratory motion. Investigation of the elements of vibrating systems: masses and inertial elements, flexible and damping elements.

Practice: Reduction of masses. Replacement of rigid bodies by lumped masses. Reduction of springs and damping elements.

11th week:

12th week:
Lecture: Investigation and properties of the free vibrations of single DOF undamped and damped systems. Solution of the homogenous motion equation.
Practice: Generating the equations of motion for single- and multiple degrees of freedom (DOF) systems.

13th week:
Lecture: Investigation and properties of the forced vibrations of single DOF undamped and damped systems. Basic types of forced vibrating systems.
Practice: Calculation examples of several kinds of forced vibrations in case of single DOF undamped and damped systems.

14th week:
Lecture: Multiple DOF systems: introduction, basic properties, natural frequencies and modes, modal transform and decoupling.
Practice: Calculation problems related to the free and forced vibrations of multiple DOF undamped and damped systems.

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 practices 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. Student can’t make up a practice with another group. Attendance at practice 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, to be discussed with the tutor.
During the semester there are two tests: the mid-term test is in the 8th week and the end-term test in the 15th week. Students have to 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 table:

<table>
<thead>
<tr>
<th>Score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-59</td>
<td>fail (1)</td>
</tr>
<tr>
<td>60-69</td>
<td>pass (2)</td>
</tr>
<tr>
<td>70-79</td>
<td>satisfactory (3)</td>
</tr>
<tr>
<td>80-89</td>
<td>good (4)</td>
</tr>
<tr>
<td>90-100</td>
<td>excellent (5)</td>
</tr>
</tbody>
</table>

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

Code: MK3ANISG06RX17-EN
ECTS Credit Points: 6
Evaluation: mid-term grade
Year, Semester: 1st year, 2nd semester
Its prerequisite(s): Engineering Physics
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 3+2

Topics:
The aim of the course is to give the basic, and useful material science knowledge to our students, 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:
- 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

<table>
<thead>
<tr>
<th>1st week</th>
<th>Registration week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd week:</td>
<td>Lecture: Overview of the groups of engineering materials and presentation of the latest material science results</td>
</tr>
<tr>
<td></td>
<td>Practice: Preparation of a metallographic sample for semester task</td>
</tr>
<tr>
<td>3rd week:</td>
<td>Lecture: Metals I - overview and presentation of metallic alloys</td>
</tr>
<tr>
<td></td>
<td>Practice: Preparation of a metallographic sample for semester task</td>
</tr>
<tr>
<td>4th week:</td>
<td>Lecture: Metals II - manufacturing technology of metals</td>
</tr>
<tr>
<td></td>
<td>Practice: Preparation of a metallographic sample for semester task</td>
</tr>
<tr>
<td>5th week:</td>
<td>Lecture: Metals III – Material testing and qualification</td>
</tr>
<tr>
<td></td>
<td>Practice: Preparation of a metallographic sample for semester task</td>
</tr>
<tr>
<td>6th week:</td>
<td></td>
</tr>
<tr>
<td>7th week:</td>
<td></td>
</tr>
</tbody>
</table>
**Lecture:** Metals IV – Theoretical background of metal alloys  
**Practice:** Microscopic analysis to complete the semester task

<table>
<thead>
<tr>
<th><strong>8th week:</strong> 1st drawing week</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th><strong>9th week:</strong></th>
</tr>
</thead>
</table>
| **Lecture:** Polymer II - Certification procedures for industrial polymers, case studies  
**Practice:** Microscopic analysis to complete the semester task |

<table>
<thead>
<tr>
<th><strong>10th week:</strong></th>
</tr>
</thead>
</table>
| **Lecture:** Ceramics I - Overview  
**Practice:** Microscopic analysis to complete the semester task |

<table>
<thead>
<tr>
<th><strong>11th week:</strong></th>
</tr>
</thead>
</table>
| **Lecture:** Ceramics II - Production technology  
**Practice:** Measurement of toughness toughness and theoretical strength calculation of the ceramic coating of the neural implant |

<table>
<thead>
<tr>
<th><strong>12th week:</strong></th>
</tr>
</thead>
</table>
| **Lecture:** Ceramics III - Qualification procedures  
**Practice:** Measurement of toughness toughness and theoretical strength calculation of the ceramic coating of the neural implant |

<table>
<thead>
<tr>
<th><strong>13th week:</strong></th>
</tr>
</thead>
</table>
| **Lecture:** Composite materials.  
**Practice:** Presentation of semester task |

<table>
<thead>
<tr>
<th><strong>14th week:</strong></th>
</tr>
</thead>
</table>
| **Lecture:** Special and Biocompatible materials.  
**Practice:** Microscopic analysis of human implants |

<table>
<thead>
<tr>
<th><strong>15th week:</strong> 2nd drawing week</th>
</tr>
</thead>
</table>

**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 a 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 table:
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”

**Law and Ethics**

Code: MK3JOGEM04XX17-EN
ECTS Credit Points: 4
Evaluation: mid-semester grade
Year, Semester: 1st year, 1st semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+0

**Topics:**

This subject helps the students to understand the basics of a legal relationship. The subject also covers the organization of power, duties, and functions of public authorities of all kinds engaged in administration; their relations with one another and with citizens and non-governmental bodies; legal methods of controlling public administration; and the rights and liabilities of officials. The subject also helps the students understand the organization of a national legislature, the structure of the courts, the characteristics of a cabinet, and the role of the head of state, and the government. It introduces sources of law and legal method, business organizations and legal relationships, contracts including the supply of goods and services. Since Hungary is a part of the European Union the subjects also covers the basic knowledge of European Union Law. Students will learn about the concepts and fundamental values of decent human conduct including the universal values and basic human rights.
Literature:
Compulsory:
- The basic Law of Hungary, Lóránt Schink, Balázs Schanda, András Zs. Varga, Clarus Press, 9781905536-45-0

Schedule

<table>
<thead>
<tr>
<th>1st week</th>
<th>Registration week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd week</td>
<td><strong>Lecture:</strong> The introduction of Hungarian legal system, the basics, the Constitution, and the sources of law in Hungary and in the European Union. The fundamental values, Hungary and basic human rights.</td>
</tr>
</tbody>
</table>

| 3rd week | **Lecture:** The basics of state administration, the legislative, executive bodies, the Parliament, the Government, the Head of state. The court system in general. |

| 4th week | **Lecture:** The role of the local governments in Hungary, and the institutes of the local administration. |

| 5th week | **Lecture:** Hungary and The European Union, the history, the legal and institutional changes since Hungary joined the EU. The sources of Law in the European Union. |

| 6th week | **Lecture:** The basic legal phrases of the civil law in Hungary and in the law of the European Union, the sources of law, the legal relationships, the law system. |

| 7th week | **Lecture:** The most important features and legal rules of the legal person. The founding documents, the common rules of legal persons (entrepreneurs), the organization of legal persons. |

<table>
<thead>
<tr>
<th>8th week</th>
<th><strong>1st drawing week</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>9th week</td>
<td><strong>Lecture:</strong> The most important features and rules of contracts in Hungarian and EU Law. The rules of the freedom of the contracts.</td>
</tr>
</tbody>
</table>

| 10th week | **Lecture:** Most important individual contracts in Hungarian and EU Law, especially sales contract, entrepreneurship contract, employment contract. |

| 11th week | **Lecture:** The working and development of the law system and sources of law in practice. The basics of Ethics and Universal values. |

| 12th week | **Lecture:** The practical introduction of the individual contracts, explaining the common rules and the differences. Also the basics of engineering ethics, and a closer look at the engineering contracts. |

| 13th week | **Lecture:** The Hungarian legal system compared with other legal systems in the |

| 14th week | **Lecture:** |
European Union, examining the continental legal system, and the common law. **Lecture:** Questions and answers, comparison of Hungarian legal system with the students home countries’.

**15th week: 2nd drawing week**

**Requirements**

**A, for a signature:**
Attendance at lectures is recommended, but not compulsory.

**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 table:

<table>
<thead>
<tr>
<th>Score</th>
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</tr>
</thead>
<tbody>
<tr>
<td>0-59</td>
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</tr>
<tr>
<td>60-69</td>
<td>pass (2)</td>
</tr>
<tr>
<td>70-79</td>
<td>satisfactory (3)</td>
</tr>
<tr>
<td>80-89</td>
<td>good (4)</td>
</tr>
<tr>
<td>90-100</td>
<td>excellent (5)</td>
</tr>
</tbody>
</table>

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

**Economics for Engineers**

Code: MK3KÖZMM04XX17-EN  
ECTS Credit Points: 4  
Evaluation: exam  
Year, Semester: 1st year, 2nd semester  
Its prerequisite(s): -  
Further courses are built on it: Yes/No  
Number of teaching hours/week (lecture + practice): 1+2

**Topics:**

Literature:

Compulsory:

Recommended:

Schedule

1st week Registration week

2nd week:
Lecture: The Scope and Method of Economics
Practice: Calculation/team problems: The circular flow Diagram. Case study examination.

3rd week:
Lecture: Measuring national output and national income (Gross Output, Gross Domestic Product, calculating GDP, real versus nominal GDP, the components of the GDP, the expenditure approach, the income approach, GDP deflator, Gross National Income, and Gross National Disposable income). Measuring the cost of living (GDP and Social Welfare, the Consumer Price Index, GDP deflator versus CPI, real and nominal interest rate).
Practice: Calculation/team problems: The expenditure approach. The difference between real GDP and nominal GDP. Macroeconomic indicators.

4th week:
Lecture: Market demand and supply, equilibrium. The Keynesian Theory of consumption, consumption function, marginal propensity to consume, planned

5th week:
Lecture: The government and fiscal policy. Government purchases, taxes, disposable income, government budget deficit and surpluses, determination of equilibrium
investment, saving function, marginal propensity to saving, aggregate output, determination of equilibrium output, the multiplier, IS curve.

Practice: Calculation/team problems: Market demand and supply, equilibrium. Two sector model.

6th week:
Practice: Calculation/team problems: Demand and supply in an open economy. Equilibrium output in an Open Economy, net exports.

8th week: 1st drawing week

9th week:
Lecture: The demand for money. Supply and demand in the money market. The equilibrium interest rate. The LM curve. The equilibrium price-level.
Practice: Mid-Term Test I

11th week:
Lecture: The demand for labour, the supply of labour. The labour force, working-age population, active and inactive population, labour participation rate. Supply curve and demand curve, equilibrium.
Practice: Calculation/team problems: Examination of the fiscal and monetary policy.

13th week:

10th week:
Lecture: Aggregate demand curve and aggregate supply curve. The effects of a shift in aggregate demand, the Equilibrium. The IS-LM model. Fiscal and monetary policy.
Practice: Calculation/team problems: The demand for money. Supply and demand in the money market. The equilibrium interest rate.

12th week:
Lecture: Unemployment, the unemployment rate, the activity rate. Types of unemployment (voluntarily and involuntarily unemployment; structural, frictional and cyclical unemployment), Okun law. Social and economic effect.
Practice: Calculation/team problems: The labour force, working-age population, active and inactive population, labour participation rate.

14th week:
Lecture: Inflation; (Price level, inflation rate, definition and measuring of inflation, types and causes of inflation, demand-pull inflation and cost-push inflation, The Philips curve: unemployment rate and inflation rate).

Practice: Calculation/team problems: Supply curve and demand curve, equilibrium. Disequilibrium in the labour market.

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 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 (ESE):
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 table:

The grade is given according to the following table:

<table>
<thead>
<tr>
<th>%</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-49</td>
<td>fail (1)</td>
</tr>
<tr>
<td>50-62</td>
<td>pass (2)</td>
</tr>
<tr>
<td>63-75</td>
<td>satisfactory (3)</td>
</tr>
<tr>
<td>76-89</td>
<td>good (4)</td>
</tr>
<tr>
<td>90-100</td>
<td>excellent (5)</td>
</tr>
</tbody>
</table>

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.
Microeconomics and Economical Processes of Enterprises for Engineers

Code: MK3MIKVM04XX17-EN
ECTS Credit Points: 4
Evaluation: exam
Year, Semester: 2nd year, 1st semester
Its prerequisite(s): Economics for Engineering
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 1+2

Topics:

Literature:
Compulsory:

or

Recommended:
### Schedule

#### 1st week Registration week

**2nd week:**
- **Lecture:** Microeconomics and Macroeconomics, models in Economics. Resources. Key analytical tools. Efficiency. Market mechanism, Demand and supply analysis. Demand curves, Supply curves; shift in demand and supply.
- **Practice:** Calculation/team problems: equilibrium price and quantity; market demand and individual demand; shifts versus movements along the demand curve (supply curve); market supply and individual supply; shifts versus movements along the supply curve.

#### 3rd week:
- **Practice:** Calculation/team problems: Relationship between utility and demand. Individual and market demand functions. Consumer surplus

#### 4th week:
- **Lecture:** Demand and supply together, market equilibrium. The elasticity of demand (price elasticity of demand, cross price elasticity of demand, income elasticity of demand). The elasticity of supply. Total revenue and the price elasticity of demand. Application of elasticity of demand. Energy and price elasticity. Types of goods (substitutes, complements, independents).
- **Practice:** Calculation/team problems: Calculation of elasticity of demand, relationship between price elasticity of demand and total revenue.

#### 5th week:
- **Practice:** Calculation/team problems and case study examination: Firm’s pricing decisions, costs estimation and decision. Sources of Cost efficiency.

#### 6th week:
- **Lecture:** Production. Inputs and production function. Total product function. Marginal product of labour and average product of labour.
- **Practice:** Calculation/team problems: Average product of labour (capital), marginal product of labour (capital), relationship between marginal product and average product.

#### 7th week:
- **Lecture:** Costs of production. (Total, fixed and variable costs, marginal and variable cost). The relationship between marginal and average cost. Total revenue, total profit curves. Calculating problems (types of cost, relationship between cost and profit. opportunity cost).
- **Practice:** Calculation/team problems: Total, fixed and variable costs; marginal and average costs. The relationship between marginal cost and average cost.
<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Practice</th>
<th>Week</th>
<th>Lecture</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>8th week</td>
<td><strong>1st drawing week</strong></td>
<td></td>
<td>10th week</td>
<td>Individual and market supply curve, main condition of the profit</td>
<td>Calculation/team problems: Profit maximization condition for competitive market.</td>
</tr>
<tr>
<td>9th week</td>
<td><strong>Lecture:</strong> Main characteristics of perfect competition, marginal cost, average costs of production, profit-maximizing output, shut down and breakeven point, the competitive firm’s supply curve. Calculating problems (marginal average, total revenue, average and marginal profit, profit-maximizing output, marginal cost curve and supply curve).</td>
<td><strong>Practice:</strong> Mid-Term Test I</td>
<td></td>
<td><strong>Lecture:</strong> Individual and market supply curve, main condition of the profit maximization and cost minimization, Cost-benefit analysis, economical examinations.</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>11th week</td>
<td><strong>Lecture:</strong> Why Monopoly arise, Monopoly (the profit-maximization condition; average revenue, marginal revenue, total revenue curves). Problems (calculation of the profit-maximization output and price. Relationship between marginal revenue and linear demand curve).</td>
<td>Calculation/team problems: Profit maximization condition for monopoly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Practice:</strong> Calculation/team problems: Profit maximization condition for monopoly.</td>
<td></td>
</tr>
<tr>
<td>13th week</td>
<td><strong>Lecture:</strong> Main characteristics of oligopoly and monopolistic competition. Markets with a few sellers, product differentiation.</td>
<td><strong>Practice:</strong> Calculation/team problems: Oligopoly market behaviour.</td>
<td>14th week</td>
<td><strong>Lecture:</strong> The markets for the factors of production. Taxes and efficiency. Earnings and discrimination. Game theory.</td>
<td>Calculation/team problems: Monopoly, Oligopoly and perfect competition. Taxes and efficiency.</td>
</tr>
<tr>
<td>15th week</td>
<td><strong>Lecture:</strong> Points on the graph: Main characteristics of information and monopolistic competition. Markets with a few sellers, product differentiation.</td>
<td><strong>Practice:</strong> Calculation/team problems: Oligopoly market behaviour.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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 (ESE):**

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 table:

<table>
<thead>
<tr>
<th>%</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-49</td>
<td>fail (1)</td>
</tr>
<tr>
<td>50-62</td>
<td>pass (2)</td>
</tr>
<tr>
<td>63-75</td>
<td>satisfactory (3)</td>
</tr>
<tr>
<td>76-89</td>
<td>good (4)</td>
</tr>
<tr>
<td>90-100</td>
<td>excellent (5)</td>
</tr>
</tbody>
</table>

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.

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**Quality and Technical Management**

Code: MK3MINMM04XX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 3rd year, 1st semester

Its prerequisite(s): Microeconomics and Economical Processes of Enterprises for Engineers

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 associated management and organizational roles and tasks. The aim of the course is to give students the opportunity to share with the
company's quality management techniques, the application of which in the European Union, as well as in Hungary, is an essential element of market competitiveness.

Literature:

**Compulsory:**


Schedule

<table>
<thead>
<tr>
<th>1st week</th>
<th>Registration week</th>
</tr>
</thead>
</table>
| 2nd week: | Lecture: Basics of Quality management  
Practice: Analyze examples |
| 3rd week: | Lecture: The role of quality management in the industry  
Practice: PDCA project |
| 4th week: | Lecture: Process Management  
Practice: Create a flowchart |
| 5th week: | Lecture: Quality Planning  
Practice: Developing a Quality Plan |
| 6th week: | Lecture: Quality Management Methods I  
Practice: Ishikawa, Pareto Analysis, 5W |
| 7th week: | Lecture: Quality Management Methods II  
Practice: QFD, Kano model, 5s, 8D report |
| 8th week: | 1st drawing week |
| 9th week: | Lecture: Engineering management  
Practice: Case study |
| 10th week: | Lecture: Company and its surroundings  
Practice: SWOT, Pestle analyzes |
| 11th week: | Lecture: Management functions, manager roles, tasks  
Practice: Situational tasks |
| 12th week: | Lecture: Organization Theory  
Practice: Process Development, Project Management |
| 13th week: | Lecture: Human Resource Management  
Practice: Recruitment, selection, work planning |
| 14th week: | Lecture: Innovation Management  
Practice: Business Plan |
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 table below:

<table>
<thead>
<tr>
<th>Grade Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fail (1)</td>
<td>0-39</td>
</tr>
<tr>
<td>Close fail (2)</td>
<td>40-50</td>
</tr>
<tr>
<td>Improvement needed (3)</td>
<td>51-60</td>
</tr>
<tr>
<td>Very good (4)</td>
<td>61-70</td>
</tr>
<tr>
<td>Excellent (5)</td>
<td>71-80</td>
</tr>
</tbody>
</table>

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:

Everybody will get an exam grade for their exam. 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”

Basics of Mechatronics

Code: MK3MEALR4RX17-EN
ECTS Credit Points: 4
Evaluation: exam
Year, Semester: 1st year, 1st semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:
The Basics of Mechatronics module has the goal to found the view after high school of an engineering student, an engineer manager and technical standpoint. The important attribute of mechatronics is the interrogation of the building blocks system, this is why it is especially important to gain a deep insight into the foundation, which during the duration of the studies will make it easier to plan the mechatronics system. We will take a look over the most important ways and actual trends in mechatronics. We will try to shed light, so that the description of the physical appearances during the engineering practice it will be known what mathematical approaches will be needed and later on we will take on other subjects as well. The job of an engineer is a lot of times physical reality mixed with abstract math and making a connection between the two. The module will try to shed light on both of these sides.

Literature:
Recommended:
- Husi Géza: Bond Graph DE MK jegyzet
- Husi Géza: Practical Tasks

Schedule
1st week Registration week
2nd week:
Lecture: Industry 4.0 mechatronics approach, the place of mechatronics if the field of engineering sciences.
Practice: Examples of four jointed mechanism themes (movement, increasing speed and strength and emphasis description exercises).

3rd week:
Lecture: Description of moving machines and introduction of their problems and on planar four jointed mechanism.
Practice: Examples of four jointed mechanism themes (movement, increasing speed and strength and emphasis description exercises).

4th week:
Lecture: Physical effects and signs of decomposing components, analytical and numerical models, mechatronics, as point of view, classical mechatronics.
Practice: Examples of four jointed mechanism themes (movement, increasing

5th week:
Lecture: Bond graphs appliance in mechatronics.
Practice: Bond graphs appliance.
speed and strength and emphasis description exercises).

6th week:
**Lecture:** Introduction to Robotics, Robotics trends.
**Practice:** Bond graphs appliance.

7th week:
**Lecture:** Opto-mechatronics trends, classical and modern appearance techniques, technics based on illusion, auto stereograms, vehicle mechatronic trends, personal vehicle mechatronics systems.
**Practice:** Rated exercise.

8th week: 1st drawing week

9th week:
**Lecture:** Modeling and simulation of mechatronics systems. Creating model – theoretical steps. The role of creating models in mechatronics planning.
**Practice:** Modeling four jointed mechanisms.

10th week:
**Lecture:** System technics: foundation concepts, grouping the systems.
**Practice:** Modeling of electrical machines.

11th week:
**Lecture:** System technics: Finite dimension dynamic system, inscription of equation.
**Practice:** Modeling of thermodynamics 2.

12th week:
**Lecture:** System technics: Finite dimension dynamic system, inscription of equation.
**Practice:** Modeling of thermodynamics 2.

13th week:
**Lecture:** System techniques: mathematical tools SISO LTI investigation of the systems functioning, Laplace operational province, bilinear appearance of frequencies reception.
**Practice:** strain gauge stamped acceleration sensor modelling 1.

14th week:
**Lecture:** System techniques: the most important control practice.
**Practice:** Strain gauge stamped acceleration sensor modelling 2.

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 homework and submission before deadline. Solving assorted tasks.

B, for a grade:
Oral exam on theoretical part.
Informatics (Labview)

Code: MK3LABVA4RX17-EN
ECTS Credit Points: 4
Evaluation: mid-semester grade
Year, Semester: 1st year, 2nd semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 0+4

Topics:

Literature:
Compulsory:
  11500 North Mopac Expressway, Austin, Texas, USA
- National Instruments Corporation – Getting Started with LabVIEW
  11500 North Mopac Expressway, Austin, Texas, USA
  11500 North Mopac Expressway, Austin, Texas, USA

Schedule

<table>
<thead>
<tr>
<th>1st week Registration week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd week:</td>
</tr>
<tr>
<td><strong>Practice:</strong> Programming Basics. Phases of programming, problem solution, programming methods, specification,</td>
</tr>
<tr>
<td>3rd week:</td>
</tr>
<tr>
<td><strong>Practice:</strong> Boolean algebra. Number representation, binary system, data types, operations with numbers, arrays, matrix operations</td>
</tr>
</tbody>
</table>

71
algorithm design, basics of graphical programming.

4th week:
Practice: Developing environment. Structure of LabVIEW Program, front panel, block diagram, navigating, menu overview, Context Help

6th week:
Practice: Cycles. Repeat controls: For Loop, While Loop, tunnels, shift registers

8th week: 1st drawing week, Test 1

9th week:
Practice: Modularity. Modular applications, SubVI creation, icon and connector pane.

11th week:
Practice: Data Acquisition. Hardware: myDAQ Device, software: DAQmx, MAX, configuration, measuring

13th week:
Practice: Design Techniques. Sequential programming, parallelism, state programming, state machine

15th week: 2nd drawing week, Test 2

5th week:
Practice: Branches, Structures. Selection controls: Select, Case Structure

7th week:
Practice: Plotting data. Data linking, clusters, Waveform chart, XY Graph

10th week:
Practice: File operations. Basic I/O operations, simple and complex file structure.

12th week:
Practice: Controls. Analog and digital input and output, serial and parallel communication

14th week:
Practice: Summary. Consultation, homework submission, sample test

Requirements
A, for a signature:
Participation at practice, according to Rules and Regulations of University of Debrecen. The correct solution of homework and submission before deadline. Solving assorted tasks.

B, for a grade:
The final grade is based on the test and task results and active participation.

Electrotechnics

Code: MK3ELTER06RX17-EN
ECTS Credit Points: 6
Evaluation: exam
Topics:
Introduction to DC circuits: voltage, current, basic components. Network analysis: Ohm’s Law, Kirchhoff’s Law, current and voltage divider, superposition, Thevenin and Norton’s Law. Alternating current circuits: sinusoidal wave, calculation on the complex plane, power and effective values. DC and AC power. Transient signals in the AC circuits: series and parallel RLC circuits. 3 phases circuit.

Literature:
Compulsory:

Schedule

1st week Registration week

2nd week:
**Lecture:** Electrostatics, DC networks: basic electrical concepts of electric charge, electric current (amperage), electric field, electric field work, electric voltage (potential), electric circuit

**Practice:** General description, laboratory regulations, Safety regulations and safety instruction

3rd week:
**Lecture:** Power source (ideal real), Power Source (ideal for real), Consumer, Ohm’s Law, Resistance - design, characteristic data, division, marking according to IEC standard.

**Practice:** Introduction to measurements and instrumentation (measuring error, power supply, digital multimeter, signal generator)

4th week:
**Lecture:** Passive resistance of bipolar networks, Star-delta, delta-star conversion, Electrical work, electric power, efficiency

**Practice:** 1st measurement: measuring the characteristics of DC voltage (U, I, RB, P) using Ohm's Law. Report writing.

5th week:
**Lecture:** Network analysis: Kirchhoff’s laws, Voltage divider, potentiometer, extending measuring range of a Volt meter current divider, extending measuring range of an Amp meter, Wheatstone bridge

**Practice:** 2nd measurement: measuring the values of DC circuit. Using Kirchhoff’s laws. Report writing.
### 6th week:

**Lecture:** Network analysis: Nodal analysis, Mesh analysis, superposition theory  
**Practice:** 3rd measurement: measuring the values of DC circuit. Using voltage and current divider. Report writing.

### 7th week:

**Lecture:** Network analysis: Norton and Thevenin theory  
**Practice:** 4th measurement: Perform a complex DC measurement and calculation task. Report writing.

### 8th week: 1st drawing week

### 9th week:

**Lecture:** AC circuit, complex number, AC circuit mean value (RMS).  
**Practice:** 5th measurement introduction to AC measurements and instrumentation (AC type digital multimeter, signal generator, oscilloscope, LRC meter). Report writing.

### 10th week:

**Lecture:** Behaviour of a resistance in AC circuit, inductance behavior in AC circuit, capacitance behavior in AC circuit.  
**Practice:** 6th measurement: Alternating current, voltage characteristics measurement ($U_{eff}$, $I_{eff}$, f, P, waveform) using Ohm’s law. Report writing.

### 11th week:

**Lecture:** AC circuit network analysis, AC Kirchhoff’s laws  

### 12th week:

**Lecture:** Performance of AC circuits, power factor correction, Three-phase systems  
**Practice:** 8th measurement: alternating current analysis of wien-bridge. Report writing.

### 13th week:

**Lecture:** Transient signals in the AC circuits  
**Practice:** 9th measurement: Measuring of serial RLC circuit. Report writing.

### 14th week:

**Lecture:** Advanced alternating current circuits: RL, RC, RLC circuits, parallel RL, RC, RLC circuits.  
**Practice:** 10th measurement: Measuring of parallel RLC circuit. Report writing.

### 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 reports until deadline.

B, for a 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)

Electronics I

Code: MK3ELT1R06RX17-EN
ECTS Credit Points: 6
Evaluation: exam
Year, Semester: 2nd year, 1st semester
Its prerequisite(s): Electromagnetism
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+4

Topics:

Literature:
Compulsory:

Schedule

<table>
<thead>
<tr>
<th>1st week Registration week</th>
<th>2nd week</th>
<th>3rd week</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lecture: Pure and doped semiconductor characteristics, PN junction behavior at forward and reverse bias conditions.</td>
<td>Lecture: Characteristics and applications of semiconductor diodes, the rectifier circuit</td>
</tr>
</tbody>
</table>
Practice: Safety regulations, laboratory order, the use of measuring instruments.

4th week:
Lecture: Bipolar transistor structure, gain, transistor parameters and characteristics, the FE connection, adjusting the set point.
Practice: DC specific analysis of common emitter basic circuit. Report writing.

6th week:
Lecture: Principles of operation of field-effect transistors.
Practice: Analysis of common source basic circuit. Report writing.

8th week: 1st drawing week
9th week:
Lecture: Feedbacks concept, types and implementation. Operational Amplifier model structure (differential amplifier, level transmitting amplifiers) and features.
Practice: Analysis of phase inverting operational amplifier basic circuit. Report writing.

11th week:
Lecture: Operation and characteristics of basic operational amplifier circuits (summing, differential, differentiator and integrator basic circuit)
Practice: Analysis of integrator operational amplifier basic circuit. Report writing.

13th week:
Lecture: Bode and Nyquist diagram


5th week:
Lecture: Areas of application of bipolar transistor, circuits transistor basic (CB, CC circuits),

7th week:
Lecture: Principles of operation of transistor amplifiers. (A, AB class, differential amp.)
Practice: Analysis of differential power amplifier basic circuit. Report writing.

10th week:
Lecture: Operation and characteristics of basic operational amplifier circuits (inverting, non-inverting, follower basic circuit)
Practice: Analysis of summing operational amplifier basic circuit. Report writing.

12th week:
Lecture: Using of the operation amplifier
Practice: Analysis of differentiator operational amplifier basic circuit. Report writing.

14th week:
Lecture: Filters: Low and high pass filter, band pass filter.
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 reports until deadline.

B, for a 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)

Mechatronic Devices (Sensors, Actuators, Motors)

Code: MK3ERZBR04RX17-EN
ECTS Credit Points: 4
Evaluation: mid-semester grade
Year, Semester: 2nd year, 2nd semester
Its prerequisite(s): Electrotechnics
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:

Types of sensors, categories of measurable quantities, static characteristics of the sensors. Typical applications of sensor systems. Sensors for high temperature measurement (infrared radiometers, pyrometers). Different level sensors (capacitance, thermal, floating, microwave, rotary paddle, etc.). Different flow sensors (induction, calorimetry, ultrasonic, thermal conductance, electromagnetic, rotameters, etc.). Measurement of kinematic quantities based on different principles: distance, speed, acceleration, vibration. The role of actuators. Types of actuators. Pneumatic actuators, valves, latches

Literature:

Compulsory:

Recommended:

Schedule

<table>
<thead>
<tr>
<th>1st week Registration week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd week:</td>
</tr>
<tr>
<td>Lecture: Definition, types of sensors, main error sources of transducers.</td>
</tr>
<tr>
<td>Practice: Application of ultrasonic distance sensor.</td>
</tr>
<tr>
<td>4th week:</td>
</tr>
<tr>
<td>Lecture: Position sensors.</td>
</tr>
<tr>
<td>Practice: Application of color sensors.</td>
</tr>
<tr>
<td>6th week:</td>
</tr>
<tr>
<td>Lecture: Flowmeters.</td>
</tr>
<tr>
<td>Practice: Application of temperature and humidity sensors.</td>
</tr>
</tbody>
</table>

| 3rd week: |
| Lecture: Static and dynamic sensor characteristics, environmental impacts on characteristics. |
| Practice: Application of pressure sensor. |
| 5th week: |
| Lecture: Level sensors. |
| Practice: Application of level sensors. |
| 7th week: |
| Lecture: High temperature measurement. |
| Practice: Application of gas sensor. |

<table>
<thead>
<tr>
<th>8th week: 1st drawing week</th>
</tr>
</thead>
<tbody>
<tr>
<td>9th week:</td>
</tr>
<tr>
<td>Lecture: Chemical sensors: humidity, gas sensor, etc.</td>
</tr>
<tr>
<td>Practice: Application of light sensors.</td>
</tr>
<tr>
<td>11th week:</td>
</tr>
<tr>
<td>Lecture: Force and torque measurement.</td>
</tr>
<tr>
<td>Practice: Application of vibration sensor.</td>
</tr>
</tbody>
</table>

| 10th week: |
| Lecture: Measurement of kinematic quantities. |
| Practice: Application of acceleration sensor. |
| 12th week: |
| Lecture: Role of actuators, types of actuators. |
| Practice: QNET Mechatronics sensor trainer. |
13th week:
Lecture: Electromechanical Actuators: DC Motors, AC Motors, Linear Motors, Stepper Motors, Midget Motors.
Practice: QNET HVAC trainer.

14th week:
Lecture: Piezoelectric actuators, magnetostriction actuators, magneto hydrodynamic activators, memory metal actuators.
Practice: QNET motors trainer.

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. The student has to prepare measurement report on every practical and has to submit the reports until deadline.

B, for a grade:
For the mid-semester grade the student has to write two tests. The mid-semester grade is received in scoring system (total 100) by the following:
- 1st test with 40 points
- 2nd test with 40 points
- quality of the measurement reports with 20 points

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

<table>
<thead>
<tr>
<th>Score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-59</td>
<td>fail (1)</td>
</tr>
<tr>
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<tr>
<td>90-100</td>
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</tr>
</tbody>
</table>

Mechanical Machines and Machine Elements

Code: MK3MGEPG04RX17-EN
ECTS Credit Points: 6
Evaluation: exam
Year, Semester: 2nd year, 1st semester
Its prerequisite(s): Engineering Physics
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

**Topics:**
The series of lectures are based on the topics of mechanics. It reviews the standardised presentation of machine elements and tolerance and fit systems; the set-up of a machine group, the connection of its elements and their operation. In the course students acquire the features of prime mowers, machines; the different types of clutches and couplings; the bearing support of shafts and the most widely applied rolling bearings; different types of frictional and positive connection drives; types of brakes and application fields. In practice the different machines and machine elements are introduced and the selection of them from brand catalogues: rolling bearings, couplings, belt and pulley, chain and sprocket.

**Literature:**

*Compulsory:*

*Recommended:*
- Optibelt: Technical Manual V-belt drives
- Rexnord: Roller Chains
- SKF General Catalogue

**Schedule**

<table>
<thead>
<tr>
<th>1st week</th>
<th>Registration week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd week:</td>
<td>Lecture: Tolerance and fit systems</td>
</tr>
<tr>
<td>3rd week:</td>
<td>Lecture: Set-up of a machine group, operation and operation requirements</td>
</tr>
</tbody>
</table>
Practice: Calculation of tolerance types and fits

4th week:
Lecture: Linkage mechanisms, types of constraints. Statically determinate, indeterminate and unstable constructions
Practice: Analyzing linkage mechanisms: suspension systems of vehicles and airplanes.

6th week:
Lecture: Shaft bearing systems. Most widely applied rolling bearings and their features.
Practice: Introduction of different types of rolling bearings and choosing them from brand catalogue.

8th week: 1st drawing week

9th week:
Lecture: Seals, operation principles. Contacting and non-contacting seals and their application fields.
Practice: Showing the different types of seals, choosing them from brand catalogues.

11th week:
Lecture: Heat balance of braking. Types of brakes, actuation of them, operation method.
Practice: Showing brakes. Analyzing the operation of them.

13th week:
Lecture: Types of chain drives, operation features, application fields.
Practice: Sprocket and chain constructions. Design of chain drive, applying design charts.

Practice: Characteristics and operation features of prime mowers, machines and precondition of stable running

5th week:
Lecture: Construction details of shafts and its parts, functions. Keyed and splined joints of shafts transmitting the peripheral force.
Practice: Construction of keyed and splined joints, sizing.

7th week:
Lecture: Bearing arrangements. Locating, non-locating bearing arrangement. Cross located bearing arrangements with adjusted or floating bearings. Selection of ball and roller bearings for service life.
Practice: Explanation of shaft bearing constructions.

10th week:
Lecture: Clutches and couplings. Types, operation features, application fields.
Practice: Stiff, flexible and universal joints. Introduction in lab and choosing from catalogues.

12th week:
Lecture: Types of belt drives, operation features, application fields.
Practice: Pulley constructions, belt sections, design of belt drive, applying design charts.

14th week:
Lecture:
Types of gear drives. Operation and their application fields.
Practice:
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 any practice 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 certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student’s behavior 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.

Students have to submit all the designing tasks as scheduled minimum at a sufficient level.

During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

B, for a grade:

The course ends in an examination. Based on the average of the grades of the designing tasks and the examination, the exam grade is calculated as an average of them:

- the average grade of the two designing tasks
- the result of the examination

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

<table>
<thead>
<tr>
<th>Score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-59</td>
<td>fail (1)</td>
</tr>
<tr>
<td>60-69</td>
<td>pass (2)</td>
</tr>
<tr>
<td>70-79</td>
<td>satisfactory (3)</td>
</tr>
<tr>
<td>80-89</td>
<td>good (4)</td>
</tr>
<tr>
<td>90-100</td>
<td>excellent (5)</td>
</tr>
</tbody>
</table>

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

An offered grade: it may be offered for students if the average grade of the designing tasks is at least good (3) and the average of the mid-term and end-term tests is at least good (3). The offered grade is the average of them.
Manufacturing Technologies

Code: MK3GYARG04RX17-EN
ECTS Credit Points: 4
Evaluation: mid-semester grade
Year, Semester: 2nd year, 1st semester
Its prerequisite(s): Engineering Physics
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:
During this semester the students learn the types of cutting machines, devices and tools. The students will know the types of basic cutting technologies (turning, drilling, milling, planning, grinding, etc.) and their characteristics. Introduction of the basic industrial design- and operation documentation procedure in manufacturing. Primary forming processes (casting, powder metallurgy, metallurgical, hot forming processes). After that the students will learn designing basic manufacturing tasks and calculating the necessary technological parameters for a given workpiece.

Literature:
Compulsory:

Recommended:
<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st week</td>
<td><strong>Registration week</strong></td>
<td></td>
</tr>
<tr>
<td>2nd week</td>
<td><strong>Lecture:</strong> The basic definitions of manufacturing processes, the types of machine tools&lt;br&gt;&lt;br&gt;<strong>Practice:</strong> Introducing of the cutting laboratory and machine tools <em>(cutting laboratory)</em></td>
<td></td>
</tr>
<tr>
<td>3rd week</td>
<td><strong>Lecture:</strong> Process of chip formation, tool wear and tool life&lt;br&gt;&lt;br&gt;<strong>Practice:</strong> Calculation tasks for tool wear and tool life</td>
<td></td>
</tr>
<tr>
<td>4th week</td>
<td><strong>Lecture:</strong> The process and tools of turning technologies&lt;br&gt;&lt;br&gt;<strong>Practice:</strong> Designing of turning technology</td>
<td></td>
</tr>
<tr>
<td>5th week</td>
<td><strong>Lecture:</strong> The process and tools of drilling and counterbore technologies&lt;br&gt;&lt;br&gt;<strong>Practice:</strong> Designing of drilling and counterbore technologies</td>
<td></td>
</tr>
<tr>
<td>6th week</td>
<td><strong>Lecture:</strong> The process and tools of milling technologies&lt;br&gt;&lt;br&gt;<strong>Practice:</strong> Designing of milling technologies</td>
<td></td>
</tr>
<tr>
<td>7th week</td>
<td><strong>Lecture:</strong> The process and tools of grinding technologies&lt;br&gt;&lt;br&gt;<strong>Practice:</strong> Designing of grinding technology</td>
<td></td>
</tr>
<tr>
<td>8th week</td>
<td><strong>8th week: 1st drawing week : Test I on cutting technologies</strong></td>
<td></td>
</tr>
<tr>
<td>9th week</td>
<td><strong>Lecture:</strong> History of metal forming. Definitions, advantages of metal forming. Bulk deformation processes. Sheet metal forming processes.&lt;br&gt;&lt;br&gt;<strong>Practice:</strong> The basic studies of technological planning on CNC machines, cutting tool selection.</td>
<td></td>
</tr>
<tr>
<td>10th week</td>
<td><strong>Lecture:</strong> Properties of materials. Industrial materials. The uniaxial tensile test. Upsetting test.&lt;br&gt;&lt;br&gt;<strong>Practice:</strong> Basic studies of Computer Aided Manufacturing (CAM). The types of manufacturing systems</td>
<td></td>
</tr>
<tr>
<td>11th week</td>
<td><strong>Lecture:</strong> Classification of manufacturing processes (casting, forming, material removal, joining). Advantages of casting. Casting terminology. Sand casting.&lt;br&gt;&lt;br&gt;<strong>Practice:</strong> Planning and finite element simulation of cold rolling technology <em>(SolidWorks and Simufact Forming)</em>.</td>
<td></td>
</tr>
<tr>
<td>12th week</td>
<td><strong>Lecture:</strong> Classification of different forming processes. Types of rolling. Rolling operations. Equipment of rolling, rolling mills. Thread rolling, ring rolling.&lt;br&gt;&lt;br&gt;<strong>Practice:</strong> Planning and finite element simulation of cold rolling technology <em>(SolidWorks and Simufact Forming)</em>.</td>
<td></td>
</tr>
<tr>
<td>13th week</td>
<td><strong>Lecture:</strong> Classification of forging operations. Types of forging dies. Overview</td>
<td></td>
</tr>
<tr>
<td>14th week</td>
<td><strong>Lecture:</strong> Manufacturing of polymers. Major processes (extrusion, injection molding,</td>
<td></td>
</tr>
</tbody>
</table>
Measurement and Data Acquisition

Code: MK3MERAR06R17-EN
ECTS Credit Points: 6
Evaluation: Mid-Semester Grade, measurement report
Year, Semester: 2nd year, 2nd semester
Its prerequisite(s): Electronics I
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:

Literature:
Compulsory:

Recommended:

Schedule

<table>
<thead>
<tr>
<th>1st week Registration week</th>
</tr>
</thead>
</table>

| 2nd week:                                                                                   |
| Practice: General description about laboratory regulations. Accident prevention and safety education. |

| 3rd week:                                                                                   |
| Lecture: Theoretical basis of Light electric effect sensors. The photodiode and photovoltaic structure, modes of operation and application. Multi-color LEDs. The structure and characteristics of optical interfaces. The scanner structure and characteristics of CCD sensors. |
| Practice: Examination of solar cell.                                                         |
4th week:
Lecture: Types of photo resist and application. The structure and features of a phototransistor. The structure and use of a light pencil. The structure, characterization and application of a liquid crystal display.
Practice: Measurement of LED characteristics.

5th week:
Practice: Measurement of elastic deformation

6th week:
Lecture: Thermoelectric sensors. The operating principles, construction and characteristics of an infrared motion sensor. Thermoelectric transducer coupling, the PVDF film. Thermocouples, semiconductor structure, function and features of metal thermometers and other thermometers.
Practice: Measurement of temperature.

7th week:
Lecture: An optical gate. Its structure, working principle and characteristics and application areas.
Practice: Measurement of an optical gate.

8th week: 1st drawing week

9th week:
Lecture: A capacitive proximity switch. Its structure, working principle, characteristics and application areas.
Practice: Measuring of capacitive proximity switch.

10th week:
Lecture: Ultrasonic sensors. Their structures, working principles, characteristics, and application areas.
Practice: Measuring of an ultrasonic distance sensor.

11th week:
Lecture: Strain gages. Foil strain gauges, semiconductor strain gauge, strain sensor wires, one, two and four-sensing bridge circuits.
Practice: Measuring of strain gages.

12th week:
Lecture: The Reed switch and magneto inductive sensors. Their structures, working principles, characteristics and Application areas.
Practice: Measuring of reed switch.

13th week:
Lecture: Description of the main features of the NI LabVIEW software.
Practice: National Instruments with hardware and software. Edit VI. Measuring system construction, Troubleshooting practice

14th week:
Lecture: Structure of the NI data acquisition systems. DAQ connecting to your computer. Practice: Recording and evaluation of data measured by National Instruments Hardware
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 absence. Missed practices should be made up for at a later date, being discussed with the tutor. 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 or her participation as an absence because of the lack of active participation in the class. Students have to submit all the twelve reports as scheduled minimum at a sufficient level. During the semester there are two tests: the mid-term test is in the 8th week and the end-term test in the 15th week.

B, for a grade:

Based on the average of the grades of the reports and the test results, the mid-semestar grade is calculated as an average of them: - the average grade of the twelve reports (50 %) - the grade of the tests (50 %). The minimum requirement for end-term test is 60%. Based on the score of the test separately, the grade for the test is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Environmental, Health, Safety and Ergonomy

Code: MK3EHSAK04RX17-EN
ECTS Credit Points: 4
Evaluation: exam
Year, Semester: 2nd year, 2nd semester
Its prerequisite(s): -
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:
The subject covers three main topics:
Environment (E): In connection with environment protection the most important topics are introduced to the students. The subject includes air quality, noise protection, water protection, soil protection, and waste management side topics.
Health (H): Basics of labor and health are discussed. The impact of work on health and the health impact on working ability is also a side topic. The fundamentals of occupational health and work hygiene are also involved.

Safety (S): It involves the basics of labor safety and fire protection. The lectures discuss the personal, material and organizational requirements for safe work, ergonomic fundamentals, personal protective equipment, work safety reviews, employer checks, and workplace risk assessment. Industrial safety and security is also a side topic.

The lectures introduce the most important aspects and the practices focus on examples and plant visits.

**Literature:**

*Recommended:*


**Schedule**

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Registration week</td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>Basics of Environmental Protection and Environmental Management</td>
<td></td>
</tr>
<tr>
<td>Lecture</td>
<td>Introduction to environmental protection</td>
<td></td>
</tr>
<tr>
<td>Practice</td>
<td>Global issues on environmental protection</td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>Air Quality Control</td>
<td></td>
</tr>
<tr>
<td>Lecture</td>
<td>Basics of air pollution control, processes in the atmosphere, greenhouse gases, ozone layer, smog, acid rain</td>
<td>Exercises in connection with air pollution</td>
</tr>
<tr>
<td>4th</td>
<td>Environmental Noise</td>
<td></td>
</tr>
<tr>
<td>Lecture</td>
<td>The basics of environmental noise</td>
<td></td>
</tr>
<tr>
<td>Practice</td>
<td>Noise measuring devices and techniques</td>
<td></td>
</tr>
<tr>
<td>5th</td>
<td>Water Protection</td>
<td></td>
</tr>
<tr>
<td>Lecture</td>
<td>Water protection and quality, pollutants</td>
<td></td>
</tr>
<tr>
<td>Practice</td>
<td>Practice in connection with water protection (plant visit: wastewater treatment plant)</td>
<td></td>
</tr>
<tr>
<td>6th</td>
<td>Soil Protection</td>
<td></td>
</tr>
<tr>
<td>Lecture</td>
<td>Protection of soil quality</td>
<td></td>
</tr>
<tr>
<td>Practice</td>
<td>Practice in connection with soil protection</td>
<td></td>
</tr>
<tr>
<td>7th</td>
<td>Waste Management</td>
<td></td>
</tr>
<tr>
<td>Lecture</td>
<td>Waste management, possibilities, disposal, techniques and hazardous waste</td>
<td>Practice in connection with waste management (plant visit)</td>
</tr>
<tr>
<td>8th</td>
<td>1st drawing week</td>
<td></td>
</tr>
</tbody>
</table>
9th week: Basics of labor safety and fire protection
Lecture: Personal, material and organizational requirements for safe work, ergonomic fundamentals
Practice: Practice in connection with labor safety I. (plant visit)

10th week: Occupational Safety
Lecture: Personal protective equipment, work safety reviews, employer checks, workplace risk assessment
Practice: Practice in connection with labor safety II. (plant visit)

11th week: Labor and Health
Lecture: The impact of work on health and the health impact on working ability
Practice: Practice in connection with occupational health I.

12th week: Occupational Health and Work Hygiene
Lecture: Fundamentals of occupational health and work hygiene
Practice: Practice in connection with occupational health II.

13th week: Industrial Safety and Security
Lecture: Main goals of industrial safety and security
Practice: Practice in connection with industrial safety and security

14th week:
Lecture: Mid-semester TEST
Practice: Mid-semester TEST

15th week: 2nd drawing week

Requirements
A, for a signature:
Attendance at practice classes (absence up to the permissible level)

B, for a grade:
Test grade (2: from 50%)

Applied Automatization I

Code: MK3AAUT1R06RX17-EN
ECTS Credit Points: 6
Evaluation: Exam, measurement report
Year, Semester: 2nd year, 2nd semester
Its prerequisite(s): Electronics I
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+4

Topics:
Control engineering of funds and core control technology, feedback (closed-loop) control knowledge acquisition. Theoretical Foundations Control Technology. Control (open-loop) and application control functions. Programmable Logic Controllers. Timers, counters, sequential controls. Tags of the control loop. Examination of the tags of the control loop steady state. linear transition state regulations. A description of the transitional state of the linear members. Examination of the closed-loop control. Stability and quality features. Selection and setting regulators. Control and feedback systems practical exercises using the PLC programming.

**Literature:**

**Compulsory:**

**Recommended:**

**Schedule**

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Registration week</td>
<td></td>
</tr>
</tbody>
</table>
| 2nd    | **Lecture:** The theoretical bases of control technology. Basic concepts, symbols and allocation. Comparison of control and feedback control. Subdivision of control and feedback control.  
**Practice:** Realization of logic functions “AND, OR, NAND, NOR, XOR, XNOR” with relays. |                                                                         |
| 3rd    | **Lecture:** Feedback control. Signs and characteristics of a control loop. Loop tags (a sensor, a signal generator, subtraction, signal processing, an amplifier, an actuator).  
**Practice:** Realization of logic functions “AND, OR, NAND, NOR, XOR, XNOR” with digital circuits. |                                                                         |
| 4th    | **Lecture:** Control systems. Boolean algebra, basic operations (And, Or, Not). Basic identity of Boolean algebra.  
**Practice:** Digital circuits realization of Flip-Flop circuits, RS-JK storage, MUX-DEMUX. |                                                                         |
| 5th    | **Lecture:** De Morgan’s theorems. Two-variable logic functions (Nor, Inhibition, Antivalency, Equivalency, Implication).  
**Practice:** Digital circuits realization of flip-flop circuits, RS-JK storage, MUX-DEMUX. |                                                                         |
| 6th    |                                                                         |                                                                         |
| 7th    |                                                                         |                                                                         |
**Lecture:** Functions to simplify algebraic and graphical way. Operation and programming of freely programmable logic controllers (PLCs).

**Practice:** Operation of programmable logic controllers. Basic programming tasks with PLC.

**8th week:** 1st drawing week, Self-control test

**9th week:**

**Lecture:** Linear control steady-state operation. Linear terms (P, I, D) and transmission coefficient. Linear coupling of tags (serial, parallel, feedback).

**Practice:** Application of different programming languages for programmable logic controllers. Medium programming tasks with PLC.

**11th week:**

**Lecture:** Analysis of proportional (type 0) control. Examination of integral (type 1) control. Gaining and measuring a concept loop.

**Practice:** Determine and analysis the transfer function of one-two variable proportional tag. Analyze the transition function of two storage proportional tags with MULTISIM software.

**13th week:**

**Lecture:** Transition, transfer function and differential equations of a proportional and integral tag. Transition, transfer function and differential equations of a derivate and dead time tag.

**Practice:** Proportional Differential (PD) tags transfer function analysis of the function using MULTISIM software.

**Lecture:** Linear Control Systems. Test methods (time domain, frequency domain, and transfer functions method).

**Practice:** Operation of programmable logic controllers. Basic programming tasks with PLC. Measuring internal timers and counters.

**10th week:**

**Lecture:** A proportional tag, negative feedback through a proportional tag. Examination of feedback.

**Practice:** Medium level programming exercises with PLC.

**12th week:**

**Lecture:** Linear feedback control transition state. Typical testing functions. Linear tags differential equations. Transfer function preparation about transmission function.

**Practice:** Conditions and analysis of a variable storage differentiator tag and its transfer function. Proportional Integral (PI) tags transfer function analysis of the function using MULTISIM software.

**14th week:**

**Lecture:** Continuous (P, PI, PD, PID) controllers. Non-electrical quantities electrical measuring. Control loops stability criterion with Routh-Hurwitz and high-quality specifics.

**Practice:** The Proportional-Integral-Derivative (PID) tag recording its transfer function and
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 a student’s behaviour 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. Students have to submit all the twelve reports as scheduled minimum at a sufficient level. During the semester there are one test: the end-term test in the 15th week. Students have to sit for these tests.

B, for a grade:
At the end of the course an oral exam must be taken. Based on the average of the grades of the reports and the test results, the mid-semester grade is calculated as an average of them: - the average grade of the twelve reports (30 %) - the grade of the tests (20 %) - the oral exam (50 %) The minimum requirement for end-term test is 60%. Based on the score of the test separately, the grade for the test is given according to the following table: Score Grade 0-59 fail (1) 60-69 pass (2) 70-79 satisfactory (3) 80-89 good (4) 90-100 excellent (5)

Applied Automatization II

Code: MK3AAUT2R06RX17-EN
ECTS Credit Points: 6
Evaluation: Mid-Semester Grade
Year, Semester: 3rd year, 1st semester
Its prerequisite(s): Applied Automatization I
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 0+6
Topics:
The most important industrial communication protocols are presented. Theoretical and practical relations PLC Modbus, CAN-bus, EtherCAT, PROFINET, TCP / IP protocol. The basic realization of the network connections of different communication architectures. Configure the listed industrial communication protocols. Getting to know a single programming environment, programming languages and typical features (Ladder Diagram (LD), structured text (ST), Function Block Diagram (FBD), Instruction List (IL) and Sequential function chart (SFC). Are different types of presentations resolution PLC (Phoenix Contact, FESTO, BECHOFF) and internal structures of the main lines of programming. Practical programming in which logic functions, timer devices, counting devices, analog control problems must be implemented both in theory and practice. Modeling of real industrial processes.

Literature:

Compulsory:

Recommended:

Schedule

<table>
<thead>
<tr>
<th>1st week Registration week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd week:</td>
</tr>
<tr>
<td>Lecture: -</td>
</tr>
<tr>
<td>Practice: Introduction, Software, Hardware, Installation.</td>
</tr>
</tbody>
</table>

| 3rd week: |
| Lecture: - |
| Practice: Configure industrial communication protocols. |

| 4th week: |
| Lecture: - |
| Practice: Getting to know a single programming environment, programming language features and characteristics. |

| 5th week: |
| Lecture: - |
| Practice: Implement basic network connections on different communication architectures. |

| 6th week: |
| Lecture: - |
| Practice: Theoretical and practical relationships Modbus programming practice. |

<p>| 7th week: |
| Lecture: - |
| Practice: Theoretical and practical connections CANbus programming practice. |</p>
<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>8th</td>
<td>-</td>
<td>1st drawing week, 1st Mid-term test</td>
</tr>
<tr>
<td>9th</td>
<td>-</td>
<td>Theoretical and practical connections EtherCAT, programming practice.</td>
</tr>
<tr>
<td>10th</td>
<td>-</td>
<td>Theoretical and practical connections PROFINET programming practice.</td>
</tr>
<tr>
<td>11th</td>
<td>-</td>
<td>Theoretical and practical connections TCP/IP programming practice.</td>
</tr>
<tr>
<td>12th</td>
<td>-</td>
<td>Modeling industrial processes.</td>
</tr>
<tr>
<td>13th</td>
<td>-</td>
<td>Managing Real Industrial Processes.</td>
</tr>
<tr>
<td>14th</td>
<td>-</td>
<td>Complex management of industrial processes.</td>
</tr>
<tr>
<td>15th</td>
<td>-</td>
<td>2nd drawing week, 2nd Mid-term test</td>
</tr>
</tbody>
</table>

### 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. 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.

**B, for a grade:**

Students have to fulfill a mid-term exercise at least for 50% to take part on the next practice classes. All students, who failed the mid-term exercise will not get a mid-semester grade. At the end of the semester, all students have to solve a real life problem in programming. Also a task, to make a complete documentation of the project file, using all the methods, mentioned during the semester. The course ends in a mid-semester grade. Based on the average of the grades of the tasks. The grade for the test is given according to the following table: Score Grade 0-50 fail (1) 51-65 pass (2) 66-75 satisfactory (3) 76-85 good (4) 86-100 excellent (5)
Pneumatics and Hydraulics

Code: MK3PNEUR04G117-EN  
ECTS Credit Points: 4  
Evaluation: mid-semester grade  
Year, Semester: 2nd year, 2nd semester  
Its prerequisite(s): Basics of Mechatronics  
Further courses are built on it: Yes/No  
Number of teaching hours/week (lecture + practice): 0+4

Topics:

Literature:
Compulsory:

Recommended:

Schedule

1st week Registration week

2nd week:  

4th week:  

3rd week:  
Practice: Compressed air production. Compressed air supply. Compressed air preparation.

5th week:
| Practice: Pneumatic actuators (structure: cylinder, rotary actuators, sizing cylinders). |
| Practice: Generally about valves (way-, closing-, pressure managing-, stop-, time-). |
| 6th week: |
| Practice: Basic circuit (single- and double acting cylinder controlling, control with And- Or elements, increase speed) |
| 7th week: |
| Practice: Functions of hydraulic equipment. Symbols and drawing techniques. |

| 8th week 1st drawing week, 1st Mid-term test |
| 9th week: |
| Practice: Structure and circuit diagrams (control, power supply) of hydraulic systems. |
| 10th week: |
| Practice: Physical basics of hydraulics (pressure transmission, force transmission, way transmission, pressure ratio). Kind of flows. |

| 11th week: |
| Practice: Equipment representation (layout drawings, wiring diagrams, operating charts). Power supply system components (gear motor, pump, filter, tank). |
| 12th week: |
| Practice: Valves (method of construction, the nominal value, slide). Pressure control valves. Way valves (2/2, 3/2, 4/2, 4/3). |

| 13th week: |
| Practice: Shut-off valves (check valve, controlled check valve). Flow control valves (one way control valves, 2 way flow control valve). |
| 14th week: |
| Practice: Hydraulic cylinders (single, double acting, sealing, venting, buckling). Hydraulic motors. |

| 15th week 2nd drawing week, 2nd Mid-term test |

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. 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.

B, for a grade:

Students have to fulfill a mid-term exercise at least for 50% to take part on the next practice classes. All students, who failed the mid-term exercise will not get a mid-semester grade. At the end of the semester, all students have to solve a real life problem in
programming. Also a task, to make a complete documentation of the project file, using all
the methods, mentioned during the semester. The course ends in a mid-semester grade.
Based on the average of the grades of the tasks. The grade for the test is given according
to the following table: Score Grade 0-50 fail (1) 51-65 pass (2) 66-75 satisfactory (3) 76-85
good (4) 86-100 excellent (5)

Electropneumatics and Electrohydraulics

Code: MK3EPNER4RX17-EN
ECTS Credit Points: 6
Evaluation: mid-semester grade
Year, Semester: 3rd year, 1st semester
Its prerequisite(s): Pneumatics and Hydraulics
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 0+4

Topics:
Basic electropneumatic circuits. General operation of electric valves. Pneumatic electrical
transducers. Pneumatic and electropneumatic controls. Electric converters, signal
processors. Relays and protection relays. Connections of electric actuated valves. Direct
and indirect management. Logic circuits. Time Tracking Control. Checking workflows.
Electric drive. Proportional pneumatics. Proportional switching valves. Applications of
FluidSIM-P program. Flow control valves. Basic electrohydraulic circuits. Electrohydraulic
control. Hydraulic cylinders. Electrohydraulic circuits. Applications of the FluidSIM-H
program. The signal storage path depends on the sequence control. Control of pneumatic
and hydraulic processes using a PLC controller.

Literature:
Compulsory:
- G. Prede, D. Scholz: Electropneumatics Basic Level Festo Didactic GmbH & Co.,
  2002.
- Dieter Scholtz: Fundamental of Electrohydraulics Festo Didactic GmbH & Co.,
- Renate Aheimer, Eberhad Bauer, Frank Ebel, Christine Löffler, Dieter Merkle,
  Helmut Werner: Electrohydraulics Basic Level Festo Didactic GmbH & Co. 2011.

Recommended:
Schedule

1st week Registration week

2nd week:
Practice: Development of electropneumatics. Pneumatic-electric transducers, relays.

4th week:
Lecture: -

6th week:
Lecture: -

3rd week:
Practice: The basic concepts of a control technology. Pneumatic and electropneumatic controls. Basics of electricity.

5th week:
Lecture: -
Practice: Sensors. Relays and contactors. Freely programmable controllers (PLC).

7th week:
Lecture: -
Practice: Relay controls. Relay controls applications. Direct and indirect control. Logic controls. Signal storage with relay.

8th week 1st drawing week, 1st Mid-term test

9th week:
Lecture: -

11th week:
Lecture: -
Practice: Electrical symbols. Electro-hydraulic controls. (hydraulic, electrical diagram, function graphs)

13th week:
Lecture: -
Practice: Electro-hydraulic circuits (signal storage way control).

10th week:
Lecture: -
Practice: Electric drive proportional pneumatics. Proportional pressure control valves. Proportional valves.

12th week:
Lecture: -
Practice: Electro-hydraulic structure of equipment. Electrical basic concepts.

14th week:
Lecture: -
Practice: Electro-hydraulic circuits (falling edge automatic mode).

15th week 2nd drawing week, Test 2

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. If a 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.

**B, for a grade:**
Students have to fulfil a mid-term exercise at least for 50% to take part on the next practice classes. All students, who failed the mid-term exercise will not get a mid-semester grade. At the end of the semester, all students have to solve a real life problem in programming. Also a task, to make a complete documentation of the project file, using all the methods, mentioned during the semester. The course ends in a mid-semester grade. Based on the average of the grades of the tasks. The grade for the test is given according to the followings: Score Grade 0-50 fail (1) 51-65 pass (2) 66-75 satisfactory (3) 76-85 good (4) 86-100 excellent (5)

**Electrical Machines and Drives**

Code: MK3VHAIJ06RX17-EN
ECTS Credit Points: 6
Evaluation: mid-semester grade
Year, Semester: 3rd year, 2nd semester
Its prerequisite(s): Mechatronic Devices (Sensors, Actuators, Motors)
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+4

**Topics:**
Literature:

Compulsory:


Schedule

1st week Registration week

2nd week:
Lecture: Classification of electrical energy converters.
Practice: Laboratory introduction and safety issues.

4th week:
Lecture: DC Machines: operating conditions.
Practice: DC motor start conditions.

6th week:
Lecture: Tri-phase transformers.
Practice: Measurement of transformers: open and short cut conditions.

8th week: 1st drawing week

9th week:
Lecture: Synchronous machines: theory and operation of tri-phase, with cylindrical rotor.
Practice: Synchronous motor starter circuits.

11th week:
Lecture: Tri-phase induction motors: load conditions and operations.
Practice: Smooth starter circuit commissioning.

3rd week:
Lecture: Direct Current electrical machines: structure, electrical and mechanical commutator.
Practice: DC motor start circuits.

5th week:
Lecture: Transformers: Theory of operation, induced voltage, open, short cut, and load conditions.
Practice: Measurement of DC machines: mechanical and electrical variables and power.

7th week:
Lecture: Theory and application of rotating fields.
Practice: Transformers: calculation of iron core and copper losses.

10th week:
Lecture: Tri-phase induction motors: theory and operational conditions.
Practice: Induction motor starter circuits.

12th week:
Lecture: Stepping motors: theory and operational conditions.
13th week:
Lecture: Special motors: EC and BLDC. Theory and operation.
Practice: VSD: Variable speed drive practice. Control.

14th week:
Lecture: Rectifier circuits. One and tri-phase.

15th week: 2nd drawing week

Requirements
A, for a signature:
Participation at practice, according to RR of UD. The correct solution of the project and submission before deadline.

B, for a grade:
The practical grade is the evaluation of the project.

Thermodynamic Processes

Code: MK3TERFR04RX17-EN
Code: MK3MOD1R06R117-EN
ECTS Credit Points: 4
Evaluation: exam
Year, Semester: 3rd year, 2nd semester
Its prerequisite(s): Basics of Mechatronics
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+2

Topics:
Literature:

Recommended:

- Robert H. Bishop: MEchatronics Handbook: Engineering thermodynamics (Chapter 12)
- Robert H. Bishop: MEchatronics Handbook: Sensors and actuators (Section Three)

Schedule

<table>
<thead>
<tr>
<th>1st week</th>
<th>Registration week</th>
</tr>
</thead>
</table>
| 2nd week | Lecture: Thermodynamics concepts and definitions, Principles.  
Practice: Thermodynamics principles practice. |
| 3rd week | Lecture: Extensive state variable balance: mass, energy, entropy balance.  
Practice: Application examples practice. |

| 4th week | Lecture: Volume change in steady state.  
Practice: Application examples practice. |
|----------|-------------------------------------|
| 5th week | Lecture: State variables: relation and table properties. P-V-T surfaces, thermodynamics table lookup, phase diagrams.  
Practice: State variable lookup practice. |
| 6th week | Lecture: Analytical derivation of state equations, ideal gas model.  
Practice: State equation practice. |
| 7th week | Lecture: Steam and gas processes.  
Practice: Process derivation practice. |

<table>
<thead>
<tr>
<th>8th week</th>
<th>1st drawing week</th>
</tr>
</thead>
</table>
| 9th week | Lecture: Thermodynamics models with Bond Graphs.  
Practice: Modelling practice. |
| 10th week | Lecture: Mechanical structures of thermodynamics systems.  
Practice: Mechanical design practice. |

| 11th week | Lecture: Electronics measurement of thermodynamics systems.  
Practice: Measurement practice. |
|----------|---------------------------------------------------------------|
| 12th week | Lecture: Data acquisition of thermodynamics system.  
Practice: Data acquisition practice. |
<table>
<thead>
<tr>
<th>13th week</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>14th week</td>
<td></td>
</tr>
</tbody>
</table>
**Lecture:** Digital control of thermodynamics system.  
**Practice:** Digital control practices.  

**Lecture:** Diagnostic and troubleshooting of thermodynamics systems.  
**Practice:** Diagnostic practices.  

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 a grade:**
The practical grade is the evaluation of the project.

**Mechatronics Comprehensive Exam**


Subject group “Differentiated Professional Subjects”

**Modelling and Simulation Prototype Technologies I**

Code: MK3MOD1R06R117-EN  
ECTS Credit Points: 6  
Evaluation: mid-semester grade  
Year, Semester: 3rd year, 1st semester  
Its prerequisite(s): Applied Automatization I  
Further courses are built on it: Yes/No  
Number of teaching hours/week (lecture + practice): 2+4

**Topics:**
Multidomain simulation with Bond Graphs. Simulation of mechanical, electrical, thermal and flow processes. Derivation of differential equations from Bond Graphs. Linearization

Sizing with simulation: derivation of parameters based on time and energy optimum. Performance measurement of simulated system using cost functions. Development of stability regions, using parameter disturbances (tolerances) and disturbance distribution.

Application of domain-specific simulation environments, solution of real-life challenges.
1. Application of building physics simulation software to model renewable energy utilization systems, and building management systems (BMS). (EnergyPlus form US DOE, NREL)
2. Complex, analog and digital electronics simulation system: static and transient analysis, parameter disturbance analysis, and effect of temperature change. (Multisim from National Instruments)
3. General purpose, multidomain, object oriented simulation environment. (Modelica and OpenModelica)

Literature:

Compulsory:

Schedule

<table>
<thead>
<tr>
<th>1st week Registration week</th>
</tr>
</thead>
</table>

| 2nd week: |
| Lecture: Multi-domain simulation with Bond Graphs: Mechanical, Electrical, Thermal and Flow process simulation. |
| Practice: Multi domain computer simulation practice. |

| 4th week: |
| Practice: Numerical solution practice. |

| 6th week: |
| Lecture: Simulated system performance measure with cost functions. |

| 3rd week: |
| Lecture: Derivation of differential equation from BondGraph. Linearization of differential equations around operational point. |
| Practice: System linearization practice. |

| 5th week: |
| Lecture: Sizing with simulation: derivation of system parameters along time and energy constraints. |
| Practice: Sizing with simulation practice. |

| 7th week: |
| Lecture: Derivation of operational stability range, against disturbance signals. |
| Practice: Operational stability practice. |
**Practice:** System performance measure practice.

**8th week:** 1st drawing week

**9th week:**
- **Lecture:** Building physics simulation software introduction.
- **Practice:** Building physics simulation practice.

**10th week:**
- **Lecture:** Building simulation with renewable energy utilisation.
- **Practice:** Renewable energy utilisation practice.

**11th week:**
- **Lecture:** Mixed, analogue and digital electrical signal simulation introduction.
- **Practice:** Mixed electrical circuit simulation practice.

**12th week:**
- **Lecture:** Steady state and transient analysis, parameter variable analysis, heat generation and cooling.
- **Practice:** Multi analysis practice.

**13th week:**
- **Lecture:** General purpose multi-domain system theory.
- **Practice:** Multi-domain simulation practice.

**14th week:**
- **Lecture:** General purpose multi-domain system applications.
- **Practice:** Multi-domain simulation practice.

**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 behavior 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, 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 table:

<table>
<thead>
<tr>
<th>Score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-39</td>
<td>fail (1)</td>
</tr>
<tr>
<td>40-52</td>
<td>pass (2)</td>
</tr>
<tr>
<td>52-63</td>
<td>satisfactory (3)</td>
</tr>
<tr>
<td>64-71</td>
<td>good (4)</td>
</tr>
<tr>
<td>72-80</td>
<td>excellent (5)</td>
</tr>
</tbody>
</table>

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.

**Modelling and Simulation Prototype Technologies II**

Code: MK3MOD2R06R117-EN
ECTS Credit Points: 6
Evaluation: exam
Year, Semester: 3rd year, 2nd semester
Its prerequisite(s): Modelling and Simulation Prototype Technologies I
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+4

**Topics:**

Mechatronics, multi domain, prototype development, using simulation results. Theory and application of mechanical and electrical prototype development. Manufacturing of mechanical parts with additive and subtractive methods. Additional coating. Attachment of commercial mechanical parts: nuts and bolts, drive types, electrotechnical parts.

Printed Circuit Board (PCB) manufacturing with rapid prototyping technologies. Surface Mounted Technology (SMD) and Trough Hole Technology (THT). Heat transfer and cooling of electrical components. Matching and attachment of commercial electrical components: analog matching or digital bus connection.

Validation of electrical circuits with measurement: analysis with periodic and non-periodic excitation signals, measurement of harmonic distortion and transfer function.

CPU and FPGA based digital control and signal processing, using model-driven software development tools, such as LabView from National Instruments.

Realization of simulation results, achieved previous subject, with rapid prototyping technologies.
**Literature:**

*Compulsory:*


**Schedule**

<table>
<thead>
<tr>
<th>Week</th>
<th>Registration week</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st week</td>
<td></td>
</tr>
</tbody>
</table>
2nd week:  
**Lecture:** Multi-domain simulation development theory.  
**Practice:** Prototype development practice.  
4th week:  
**Lecture:** Production of mechanical parts with subtractive and additive methods. Surface treatment methods.  
**Practice:** Mechanical part manufacturing practice.  
6th week:  
**Lecture:** Rapid prototyping of printed circuit boards. Modules and components.  
**Practice:** Printed circuit design practice.  
8th week:  
9th week:  
**Lecture:** Electrical interfacing to commercial components. Analogue and digital interfacing. Connection to digital bus.  
**Practice:** Electrical interfacing design and manufacturing practice.  
11th week:  
3rd week:  
**Lecture:** Electrical and mechanical prototype development theory.  
**Practice:** Electrical and mechanical prototype manufacturing practice.  
5th week:  
**Lecture:** Design with commercial mechanical components: nuts and bolts, gears, and electromechanical components.  
**Practice:** Design practice with commercial components.  
7th week:  
**Lecture:** Through hole (THT) and surface mounted technologies for electrical circuits and boards. Heat dissipation and cooling.  
**Practice:** THT and SMD soldering and testing practice.  
8th week:  
9th week:  
**Lecture:** Testing of electrical components and modules with periodic and non-periodic excitation signals.  
**Practice:** Electrical modules testing practice.  
12th week:  
**Lecture:** Model driven software development tools, theory. |


**Lecture:** Testing of electrical components and modules: distortion and transfer characteristics.

**Practice:** Electrical components testing practice.

**13th week:**

**Lecture:** Digital control and signal processing with CPU.

**Practice:** Control and signal processing with CPU practice.

**14th week:**

**Lecture:** Digital control and signal processing with FPGA.

**Practice:** Control and signal processing with FPGA practice.

**15th week: 2nd drawing week**

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**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 8th 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 table:

<table>
<thead>
<tr>
<th>%</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-49</td>
<td>fail (1)</td>
</tr>
<tr>
<td>50-62</td>
<td>pass (2)</td>
</tr>
<tr>
<td>63-75</td>
<td>satisfactory (3)</td>
</tr>
<tr>
<td>76-89</td>
<td>good (4)</td>
</tr>
<tr>
<td>90-100</td>
<td>excellent (5)</td>
</tr>
</tbody>
</table>

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.
Robots and Robotics Technology

Code: MK3ROBR6R117-EN
ECTS Credit Points: 6
Evaluation: 6 exam
Year, Semester: 2nd year, 1st semester
Its prerequisite(s): Mechatronic Devices (Sensors, Actuators, Motors), Applied Automatization I
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 2+4

Topics:
Material handling, combined application of technological and material handling systems, synchronizing tasks. Introducing the concept of „Intelligent Space”: robots in human spaces. Robot simulation.

Literature:
Compulsory: -

Schedule

1st week Registration week

2nd week:

3rd week:
**Practice:** Accident prevention. Solving tasks using Denavit-Hartemberg parameters, Jacobi matrix.

**4th week:**
**Lecture:** 6DOF robots: structural elements, drives.
**Practice:** Robot control (6DOF or 4 DOF) – operator level.

**6th week:**
**Lecture:** 6DOF robots: Point-to-point and continuous path control of robots. Point-to-point control.
**Practice:** Robot control (6DOF or 4 DOF) – operator level.

**8th week: 1st drawing week**
**9th week:**
**Lecture:** 4DOF (Scara) robots: structural elements, coordinate control, point-to-point control, continuous path control.
**Practice:** Robot control (6DOF or 4 DOF) – operator level.

**11th week:**
**Lecture:** Offline robot programming.
**Practice:** Offline robot programming.

**13th week:**
**Lecture:** Autonomous robots and their simulation.
**Practice:** Robot simulation.

**15th week: 2nd drawing week**

**Practice:** Solving tasks using Denavit-Hartemberg parameters, Jacobi matrix.

**5th week:**
**Lecture:** 6DOF robots: coordinate systems, installing coordinate systems.
**Practice:** Robot control (6DOF or 4 DOF) – operator level.

**7th week:**
**Lecture:** 6DOF robots: Singularity of robots.
**Practice:** Robot control (6DOF or 4 DOF) – operator level.

**10th week:**
**Lecture:** Offline robot programming.
**Practice:** Mid-term test (theoretical), Robot control – classified.

**12th week:**
**Lecture:** “Intelligent Space”: robots in human spaces.
**Practice:** Offline robot programming.

**14th week:**
**Lecture:** Robot simulation.
**Practice:** Robot simulation.

**Requirements**

**A, for a signature:**
Attendance at practical classes (see Rules and Regulations). Submitting homework assignments until the deadline. Passing the mid-term test.

**B, for a grade:**
Oral exam on the theoretical part.
**Caxx Techniques**

Code: MK3CAXXR06R117-EN  
ECTS Credit Points: 6  
Evaluation: mid-semester grade  
Year, Semester: 3rd year, 2nd semester  
Its prerequisite(s): Modelling and Simulation Prototype Technologies I  
Further courses are built on it: Yes/No  
Number of teaching hours/week (lecture + practice): 2+4  

**Topics:**  
CAXX technology theory summary: CAD, CAPP, CAM. Computer aided principles and technologies of machine production. Productivity and troubleshooting measurement with computer aided tools. Teamwork and cooperation with CAXX technologies.  
CAXX technologies for Mechanical engineering practice: geometry design: creation of simple and complex surfaces and volumes. Modell extension with material, load and manufacturing properties. Connection of CAXX and CNC technologies. Practical examples: design and modelling of mechanism and drives.  
Final element method (FEM) design in mechanical and electrical engineering practices.  
Manufacturing with Rapid prototyping: material removal (cutting) and additive technologies. Rapid prototype manufacturing for mechanical and electrical engineering products.  

**Literature:**  
*Compulsory:*  

**Schedule**

<p>| 1st week Registration week | 2nd week | 3rd week: |</p>
<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>4th</td>
<td><strong>Lecture:</strong> CAXX technology: cooperation and teamwork.</td>
<td><strong>Practice:</strong> Practice on CAXX technology: productivity and teamwork.</td>
</tr>
<tr>
<td>6th</td>
<td><strong>Lecture:</strong> CAXX technologies for Mechanical engineering practices: material and load properties.</td>
<td><strong>Practice:</strong> CAXX technologies for Mechanical engineering practices: material and load properties practice.</td>
</tr>
<tr>
<td>8th</td>
<td><strong>8th week: 1st drawing week</strong></td>
<td></td>
</tr>
<tr>
<td>9th</td>
<td><strong>Lecture:</strong> CAXX technologies for Electrical engineering practice: control cabinet design.</td>
<td><strong>Practice:</strong> CAXX technologies for Electrical engineering practice: control cabinet design practice.</td>
</tr>
<tr>
<td>11th</td>
<td><strong>Lecture:</strong> CAXX technologies for Electrical engineering practice: printed circuit design.</td>
<td><strong>Practice:</strong> CAXX technologies for Electrical engineering practice: printed circuit design practice.</td>
</tr>
<tr>
<td>13th</td>
<td><strong>Lecture:</strong> Rapid prototyping: manufacturing with cutting technology.</td>
<td><strong>Practice:</strong> Rapid prototyping: cutting manufacturing practice.</td>
</tr>
<tr>
<td>15th</td>
<td><strong>15th week: 2nd drawing week</strong></td>
<td></td>
</tr>
<tr>
<td>10th</td>
<td><strong>Lecture:</strong> CAXX technologies for Electrical engineering practice: component packages and modules.</td>
<td><strong>Practice:</strong> CAXX technologies for Electrical engineering practice: packages and modules design practice.</td>
</tr>
<tr>
<td>12th</td>
<td><strong>Lecture:</strong> Rapid prototyping: manufacturing technology theory.</td>
<td><strong>Practice:</strong> Rapid prototyping: practice.</td>
</tr>
<tr>
<td>14th</td>
<td><strong>Lecture:</strong> Rapid prototyping: manufacturing with additive technology.</td>
<td><strong>Practice:</strong> Rapid prototyping: additive manufacturing practice.</td>
</tr>
</tbody>
</table>
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 behavior 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, 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 table:

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<tr>
<td>64-71</td>
<td>good (4)</td>
</tr>
<tr>
<td>72-80</td>
<td>excellent (5)</td>
</tr>
</tbody>
</table>

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.

Cyber-physical Systems

Code: MK3KIBRR6R117-EN
ECTS Credit Points: 6
Evaluation: mid-semester grade
Year, Semester: 3rd year, 2nd semester
Its prerequisite(s): Modelling and Simulation Prototype Technologies I
Further courses are built on it: Yes/No
Number of teaching hours/week (lecture + practice): 0+4

Topics:
The industry’s 4.0 manufacturing technology trends, its upgrades are inseparable from the total transformation of industrial proceedings. The new approach to manufacturing and some aspects of it worldwide is a paradigm with different names (industrial internet, industry 4.0, cyber physical manufacturing system) one of its building blocks contains the practical teaching of the module. One of the logical explanations can be found in the BMBF (Bundesministerium fur Bildung und Forschung – german alliance educational and research minister) obtaining finance section: „The flexibility of the cyber physical systems increases the usage of manufacturing systems (CPPS). This makes it possible for machines and sites to optimize themselves and reconfigure, their behaviour change in regards to the changing orders and manufacturing conditions. The interrelationship between the real and the digital world, in the modern manufacturing sites it creates the foundation for the „internet of things“. In the centre of the systems there is a capability, to feel all incoming information, and conduct recognition out of this, and according to this they change their behaviour, and store the knowledge gained by experience. The intelligent manufacturing systems and processes, and the goal oriented engineering plans, methods and tools will become the most important factors of the shared and connected manufacturing winery, for the successful creation in the future „intelligent manufacturing sites,“. The intelligent manufacturing sites original conception, the internet of things. This phrase was created in 1999 to put everyday items in a web and the web operation RFID and sensory technology together. The expression ‘cyber physical systems’ (CPS) was first written down in 2006 as unified actualization of minimal requirements.

Literature:
Recommended:
• https://www.beckhoff.hu/
• http://graphit.hu/tecnomatix/

Schedule

1st week Registration week
<table>
<thead>
<tr>
<th>Week</th>
<th>Practice</th>
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<tr>
<td>2nd week</td>
<td>Creation of virtual production with discrete event-driven production &amp; logistics. (with the most up to date software, 2017. TECNOMATIX/PLANT SIMULATION.</td>
</tr>
<tr>
<td>4th week</td>
<td>Creation of virtual production with discrete event-driven production &amp; logistics. (with the most up to date software, 2017. TECNOMATIX/PLANT SIMULATION.</td>
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<td>6th week</td>
<td>Creation of virtual production with discrete event-driven production &amp; logistics. (with the most up to date software, 2017. TECNOMATIX/PLANT SIMULATION.</td>
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<td>8th week</td>
<td><strong>1st</strong> drawing week</td>
</tr>
<tr>
<td>9th week</td>
<td>Project selection &amp; individual consultation.</td>
</tr>
<tr>
<td>11th week</td>
<td>Individual Consultation.</td>
</tr>
<tr>
<td>13th week</td>
<td>Individual Consultation.</td>
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<tr>
<td>15th week</td>
<td><strong>2nd</strong> drawing week</td>
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<tr>
<td>10th week</td>
<td>Individual Consultation.</td>
</tr>
<tr>
<td>12th week</td>
<td>Individual Consultation.</td>
</tr>
<tr>
<td>14th week</td>
<td>Project submission &amp; presentation.</td>
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<tr>
<td>15th week</td>
<td>2nd drawing week</td>
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Requirements

**A, for a signature:**
Participation on practice, according to Rules and Regulations of University of Debrecen. The correct solution of the project and submission before deadline.

**B, for a grade:**
The practical grade is the evaluation of the project.

**Project of Mechatronics**
Individual Project Work
Within 30 days of the successful final exam the diploma is issued and given out by the Faculty at the graduand’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 Mechatronics Engineering undergraduate 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; specialization; mode of attendance; place, day, month and year issued. Furthermore, it has to contain the dean’s (or vice-dean’s) original signature and the seal of HEI. It has to contain the dean’s (in case of being prevented from attending the vice-dean for educational affairs) original signature and the imprint of the official stamp of the tertiary institute.

At the graduand’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\(0.3 \times B + 0.2 \times C + 0.5 \times A\), where
- A: Average of comprehensive exams \(A = 0.3 \times \text{mathematics comp. exam} + 0.7 \times \text{mechatronics comp. exam}\)
- B: Average of the grades of the subjects of the state exam
- C: Grade for defending thesis

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

<table>
<thead>
<tr>
<th>Classification</th>
<th>Grade Range</th>
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<tr>
<td>Excellent</td>
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<tr>
<td>Very good</td>
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<td>Good</td>
<td>3.51 – 4.50</td>
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<td>Satisfactory</td>
<td>2.51 – 3.50</td>
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<td>Pass</td>
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Award with Distinction

An award with Distinction is permitted where a student obtained grade 5 in all subjects of the state exam. The average of thesis grade, his/her exam grades and mid-semester grades during his/her studies is at least 4.00. Moreover, he/she is not permitted to have a grade worse than grade 3 during his/her studies.
<table>
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<tr>
<th>Nr.</th>
<th>Subject group</th>
<th>Specialties</th>
<th>Subject name</th>
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<th>2nd semester</th>
<th>3rd semester</th>
<th>4th semester</th>
<th>5th semester</th>
<th>6th semester</th>
<th>7th semester</th>
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<td>Engineering Computer Aided Modelling</td>
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</tbody>
</table>

**Bachelor of Mechatronics Engineering (BSc) degree program: Specialization in Mechatronics Systems**

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